mGuard device manager

Reference Manual

mdm Version 1.6
Document Rev. 02

Innominate Security Technologies AG
Rudower Chaussee 13
12489 Berlin, Germany
Tel.: +49-30-921028 0
contact@innominate.com
http://www.innominate.com/

Copyright © 2006-2014 Innominate Security Technologies AG

November 2014
"Innominate" and "mGuard" are registered trade names of Innominate Security Technologies AG. The mGuard technology is protected by the German patents #10138865 and #10305413. Further national and international patent applications are pending.
This document may not be copied or transferred in whole or in part without prior written approval.
Innominate reserves the right to modify this document at any time without notice.
Innominate provides no warranty for the contents of this document. This disclaimer shall also apply to any implicit warranty of marketability or suitability for a specific purpose.
Furthermore, Innominate assumes no liability for errors in this manual or for accidental or consequential damages in connection with the delivery, performance or utilization of this document.
This manual may not be photocopied, duplicated or translated into another language in whole or in part without the prior written approval of Innominate Security Technologies AG.

SSH®, SSH Secure Shell™ are trademarks of SSH Communications Security.
Windows®, Windows NT®,and Windows Server™ are trademarks of Microsoft® Corporation.

This product includes the following software:

PostgreSQL JDBC driver:
Copyright © 1997-2010 PostgreSQL Global Development Group.

Jetty:
Copyright © 1995-2007 Mort Bay Consulting Pty. Ltd.
Copyright © 1999 Jason Gilbert.
Copyright © 1999-2005 Sun Microsystems, Inc. All rights reserved.
Copyright © 2002 International Business Machines Corporation.
Copyright © 2004-2006 The Apache Software Foundation.
Copyright © 2006 Tim Vernum.
Copyright © 2007 CSC Scientific Computing Ltd.

Commons DBCP:
Copyright © 1999-2007 The Apache Software Foundation.

Commons Pool:
Copyright © 1999-2004 The Apache Software Foundation.

Commons Codec:
Copyright © 2001-2004 The Apache Software Foundation.

Commons HttpClient:
Copyright © 1999-2007 The Apache Software Foundation.

Commons Logging:
Copyright © 2003-2007 The Apache Software Foundation.

Tar library from Ant:
Copyright © 1999-2006 The Apache Software Foundation.

Bouncy Castle Provider and CMS:
Copyright © 2000-2010 The Legion Of The Bouncy Castle
(http://www.bouncycastle.org).

jSCEP:
Copyright © 2009-2010 David Grant.
Copyright © 2010 ThruPoint Ltd.

JSch and **JZlib**:
Copyright © 1995-1998 Jean-loup Gailly and Mark Adler.
Copyright © 2000-2009 Atsuhiko Yamanaka, JCraft, Inc. All rights reserved.

JGoodies Common library from JGoodies:
Copyright © 2009-2011 JGoodies Karsten Lentzsch. All rights reserved.

JGoodies Looks library from JGoodies:
Copyright © 2001-2011 JGoodies Karsten Lentzsch. All rights reserved.

TinyRadius:
Copyright © 2005-2010 Matthias Wuttke.

See the license texts included in the software distribution for the copying terms applying to these software components.

The source code for these software components is contained on the *mGuard device manager* CD.

Innominate Document Number: UG301602914-055

Contents

1 Introduction 6

2 Installation 7

2.1 System requirements 7
2.2 Upgrading from an earlier version 7
2.3 Installation on a Microsoft Windows server 8
2.4 Manual installation of the mdm client, the mdm server and the database 12
2.4.1 Installation on Windows 12
2.4.2 Installation on Linux 17
2.5 Installation of the license 19
2.6 mdm server configuration 19
2.7 Start the mdm server and the mdm client 26
2.8 mdm Certification Authority (CA) installation 28
2.8.1 Overview 28
2.8.2 Installation procedure 29
2.8.3 Creation of the keys and certificates using the demoCA scripts 29
2.8.4 Manual creation of the CA keys and certificates 33
2.8.5 Configuration of the mdm CA 34
2.8.6 Starting the CA 37
2.9 Pre-configuration of the mGuards 39
2.10 Installation of an HTTPS configuration pull server 39
2.11 Securing the communication between mdm components 39
2.11.1 Create the private key and the keystore for each component 40
2.11.2 Create the truststores 42

3 mdm client overview 44

3.1 Login 44
3.2 The mdm main window 45
3.3 Device overview table 45
3.3.1 The device context menu 50
3.4 Template overview table 54
3.4.1 The template context menu 56
3.5 Pool value overview table 57
3.5.1 The pool context menu 58
3.6 VPN group overview table 59
3.6.1 The VPN group context menu 60
3.6.2 Editing device membership in VPN groups 61
3.7 Log window 62
3.7.1 The persistent event log 63
3.7.2 Logging events via syslog 64
3.8 The mdm main menu and tool bar 64
3.8.1 The mdm main menu 64
3.8.2 The mdm tool bar 66
3.9 Uploading configurations to the mGuards 67
3.10 Managing license vouchers and device licenses 70
3.11 Managing users, roles, and permissions 72
3.11.1 Managing users 73
3.11.2 Managing roles 74

3.11.3 Permissions 74
3.11.4 User authentication 75
3.12 Managing firmware upgrades with mdm 75
3.13 Hardware flavors 77

4 Template, device, pool, and VPN group configuration 78
4.1 General remarks 78
4.2 The Template Properties Dialog 85
4.2.1 Template configuration 87
4.3 The Device Properties Dialog 88
4.4 The Pool Properties Dialog 91
4.5 VPN configuration 93
4.6 Managing X.509 certificates 95
4.6.1 Machine certificates 95
4.6.2 CA certificates (mGuard firmware 5.0 or newer) 97
4.6.3 Remote certificates (mGuard firmware 5.0 or newer) 97
4.6.4 Connection certificates 98
4.7 Using X.509 certificates (mGuard firmware 5.0 or newer) 98
4.8 The VPN Group Properties Dialog (Meshed VPN networks) 98
4.9 Rollback support 100
4.10 Redundancy mode 100

5 Working with templates 102
5.1 Inheritance 102
5.2 Miscellaneous 104
5.2.1 Complex table variables and permissions 104
5.2.2 Firmware release settings and inheritance 104

6 Configuration history 105
6.1 The configuration history dialog 105
6.2 Viewing historic configurations 107
6.3 Comparison of historic configurations 108
6.4 Reconstructing a device from a historic configuration 109
6.5 Report of changes 109

7 Creating and managing certificates 111
7.1 Certificates and keys for SSL 111
7.2 Certificates and keys for a PKI 114
7.2.1 Create the CA certificates 117
7.2.2 Create the keystores 125
7.2.3 Requirements for certificates 127

8 Glossary 128

1 Introduction

Thank your for choosing **mGuard device manager.**
Please read this document for information on

- the installation of mGuard device manager,
- how to efficiently generate configurations for your Innominate mGuards, and
- how to upload configurations to your Innominate mGuards.

Overview

mGuard device manager enables the convenient management of Innominate mGuard security appliances. The tool offers a template mechanism that allows to centrally configure and manage thousands of Innominate mGuard devices.
With a click of your mouse you can generate the desired firewall rules, NAT settings, etc., and upload the generated configurations to the devices in the network, deploying in an instant your desired device configurations.
mdm is a client-server application, the client offering full control of all mdm features, the server storing the configuration in a database, generating configuration files, and uploading those files to the devices upon request.
If a configuration is uploaded to a device, mdm generates a configuration file which is transferred via SSH to the device and is subsequently taken into operation. Furthermore mdm can generate configuration files to be used for the configuration pull feature of the Innominate mGuard. Additionally, mdm can trigger firmware upgrades and deploy device licenses.

Supported devices

mdm 1.6 supports Innominate mGuard firmware 5.0.x to 8.1.x.

Related documentation

Detailed information of limitations and known issues can be found in the document *mdm Release Notes Version 1.6.x* at www.innominate.com.
Detailed information on the Innominate mGuard can be found in the following documents at www.innominate.com:

- *Reference Manual mGuard Firmware*
- *Reference Manual mGuard Appliances*
- Application note *Rollout support*

2 Installation

2.1 System requirements

	mdm Client	mdm Server	mdm CA
Hardware	• A minimum of 512 MB RAM • 500 MB free hard disk space • Color monitor with at least 1280 x 1024 resolution	• A minimum of 4 GB RAM • 100 GB free hard disk space	• A minimum of 512 MB RAM • 5 GB free hard disk space
Software	• Windows 2000 SP 2 / XP (or later), Windows Server 2003 (or later), or Linux • Java Runtime Environment JRE SE 7	• Windows 2000 SP 2 / XP (or later), Windows Server 2003 (or later), or Linux • Java Runtime Environment JRE SE 7 • PostgreSQL Version 9.0 or later	• Windows 2000 SP 2 / XP (or later), Windows Server 2003 (or later), or Linux • Java Runtime Environment JRE SE 7 • PostgreSQL Version 9.0 or later

☞ The product has been renamed from Innominate Device Manager (IDM) to mdm (mGuard device manager). File and directory names have been changed accordingly. Please note that external scripts etc. relying on file or directory names need to be adapted.

The PostgreSQL database does not support the FAT32 file system. In case you would like to install the PostgreSQL database on a system with FAT32 file system, it is strongly recommended to convert the file system to NTFS by using the *convert.exe* command before installing PostgreSQL. For more information on the convert-tool please enter `help convert` on the command line.

Download

Contact the Innominate Sales Department for information on how to obtain the software and a license. Please visit the web site **http://www.innominate.com/** and click on **Contacts » Inquiries**.

2.2 Upgrading from an earlier version

Since mdm 1.5 and later no longer supports firmware versions 4.2.x, all devices and templates must be set to at least firmware versions 5.0 before installing mdm 1.6.

To upgrade from an earlier version to mdm 1.6, it is necessary to make irreversible changes to the backing PostgreSQL database. Once these changes have been made, the database can no longer be accessed with an earlier version.

1. Stop the mdm (formerly IDM) server if it is running.
2. Dump the content of the mdm/IDM database. The command line tools `pg_dump` or `pg_dumpall` (part of the PostgreSQL distribution), the graphical front-end *pgAdmin III*, or another mechanism can be used for this. See the PostgreSQL documentation for details.
3. If the mdm CA is used, dump the content of the CA database.

   ☞ It is strongly advised to keep a copy of the database dumps as a backup.
4. Install the mdm 1.6 server. Since the server configuration file *preferences.xml* has been extended, it is recommended to use and customize the file provided with mdm 1.6. By default, the passwords for the Java trust

store, Java key store, and database connection are read from environment variables; set these environment variables accordingly.
Note that the CA type “IDM-CA” has been renamed to “mdm-CA”. It is necessary to adapt the key ***com » innominate » innomms » is » CA » type*** in *preferences.xml* accordingly or communication with the mdm CA will fail.

5. mdm 1.6 requires the Java SE 7 Runtime Environment (JRE). Make sure the `java` command refers to a JRE of this version, or use an appropriate pathname to run a Java SE 7 JRE.
6. Invoke the server with the following command:

   ```
   java -Xmx1024m -jar mdm-server-1.6.x.jar update preferences.xml
   ```

   The server will connect to the PostgreSQL database, upgrade it, and terminate. After this step, the database is ready to be used by mdm 1.6, i.e. the mdm 1.6 server can now be started.

2.3 Installation on a Microsoft Windows server

If you plan to run the mdm server, the PostgreSLQ database server, and the CA server (if applicable) on a single Microsoft Windows server, an automatic installer program can be used. The installer program can additionally set the server up as a configuration pull server (see Chapter 3.9) or as a firmware upgrade server (see Chapter 3.12).

Supported Microsoft Windows versions

The following versions of Microsoft Windows are supported by the installer:

- Windows Server 2012 (64 Bit)
- Windows Server 2008 R2 SP1 Enterprise Edition (64 Bit)
- Windows Server 2008 SP1 Enterprise Edition (64 Bit)
- Windows Server 2008 SP1 Enterprise Edition (32 Bit)
- Windows Server 2003 SP2 Enterprise Edition (64 Bit)
- Windows Server 2003 SP2 Standard Edition (64 Bit)
- Windows Server 2003 SP2 Standard Edition (32 Bit)

Since the installer program sets up a PostgreSQL database server and a ***https*** web server, it will fail if a PostgreSQL server or ***https*** server are already running on the system. A running web server is fine as long as it does not serve the ***https*** default TCP port (443).

mdm installation

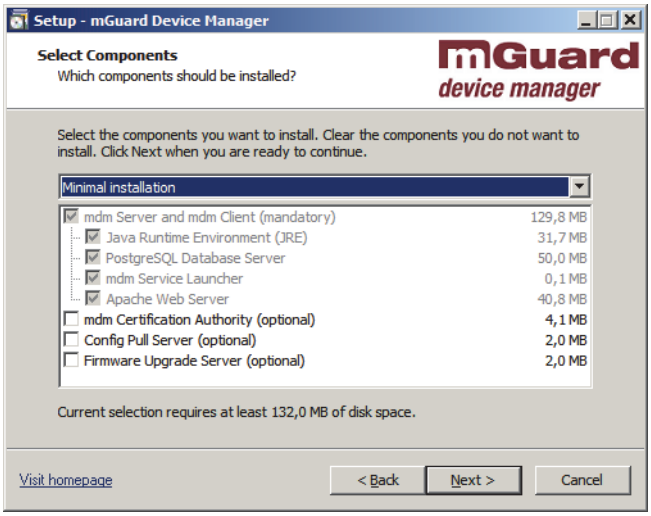
Follow these steps to install mdm:

1. Insert the mdm CD and run the installer program with administrator rights. Click the ***Next*** button on the greeting screen and accept the mdm and third-party software licenses on the following two screens.
2. Select a location where to install mdm.

Setup - mGuard Device Manager
Select Destination Location
Where should mGuard Device Manager be installed?
mGuard
device manager
Setup will install mGuard Device Manager into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
C:\Program Files\mGuard Device Manager
Browse...
At least 132,0 MB of free disk space is required.
Visit homepage
< Back
Next >
Cancel

The default location usually need not be modified.

3. Choose which mdm components to install.

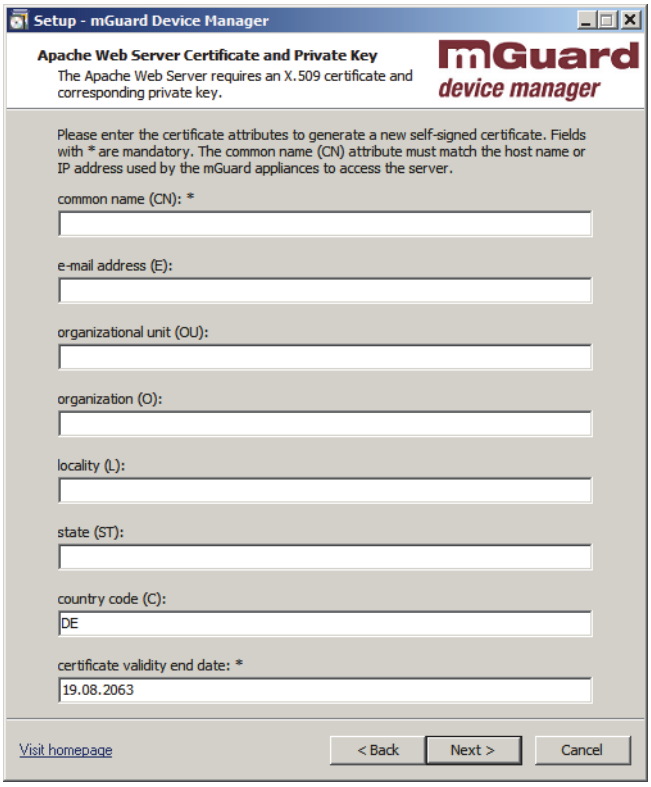

Setup - mGuard Device Manager
Select Components
Which components should be installed?
mGuard
device manager
Select the components you want to install. Clear the components you do not want to install. Click Next when you are ready to continue.
Minimal installation
mdm Server and mdm Client (mandatory) 129,8 MB
Java Runtime Environment (JRE) 31,7 MB
PostgreSQL Database Server 50,0 MB
mdm Service Launcher 0,1 MB
Apache Web Server 40,8 MB
mdm Certification Authority (optional) 4,1 MB
Config Pull Server (optional) 2,0 MB
Firmware Upgrade Server (optional) 2,0 MB
Current selection requires at least 132,0 MB of disk space.
Visit homepage
< Back
Next >
Cancel

The mdm server, Java runtime environment, PostgreSQL server, mdm service launcher (used to run the mdm server as a service), and Apache web server are always installed, while the mdm CA is optional. The Apache web server can also optionally be set up as configuration pull server and a firmware upgrade server.

☞ The mdm client is made available to other hosts through the web server. Such hosts need to have a Java runtime environment installed. To run the client, download the *ZIP* file from the web server, unpack it, and start the `mdm-client-1.6.x.jar` file.

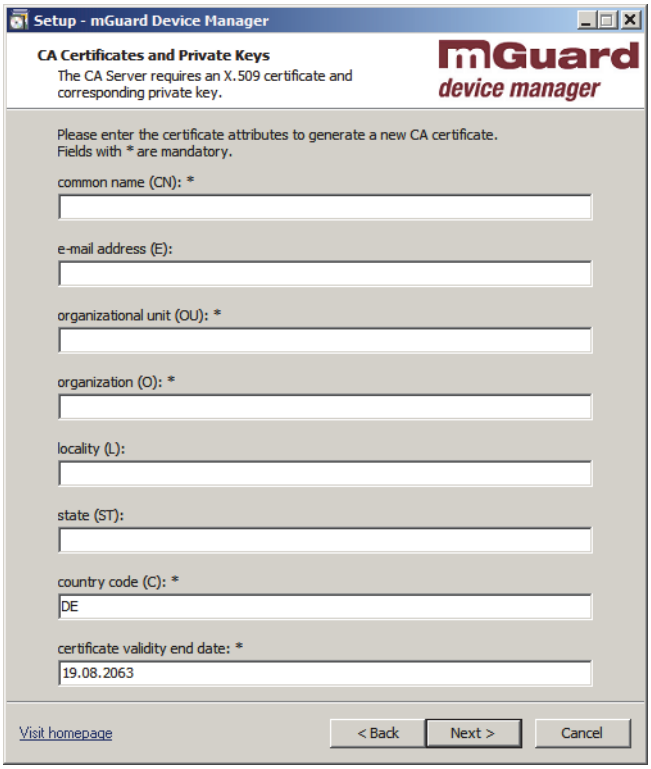
4. Provide a license file for the mdm server.

5. The installer program creates a self-signed X.509 certificate and matching private key to be used by the https web server. Enter attributes to be used for the certificate.


Setup - mGuard Device Manager
Apache Web Server Certificate and Private Key
The Apache Web Server requires an X.509 certificate and corresponding private key.
mGuard
device manager
Please enter the certificate attributes to generate a new self-signed certificate. Fields with * are mandatory. The common name (CN) attribute must match the host name or IP address used by the mGuard appliances to access the server.
common name (CN): *
e-mail address (E):
organizational unit (OU):
organization (O):
locality (L):
state (ST):
country code (C):
DE
certificate validity end date: *
19.08.2063
Visit homepage
< Back
Next >
Cancel

6. Access to the directories served by the web server can optionally be protected with a user name and password. Choose whether you want this protection, and if so, enter a user name and password.

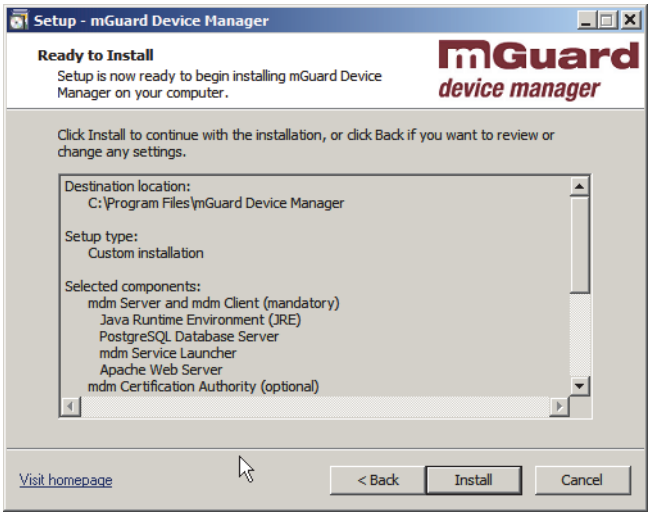
7. The following applies only if the mdm CA is installed: The installer program creates a CA certificate and matching private key. Enter attributes to be used for the certificate.



8. The installer can optionally add shortcuts to the Start menu. If this is desired, choose a folder to which to add the shortcuts.

Setup - mGuard Device Manager
Select Start Menu Folder
Where should Setup place the program's shortcuts?
mGuard
device manager
Setup will create the program's shortcuts in the following Start Menu folder.
To continue, click Next. If you would like to select a different folder, click Browse.
mGuard Device Manager
Browse...
Don't create a Start Menu folder
Visit homepage
< Back
Next >
Cancel

9. Click on the **Install** button.


Setup - mGuard Device Manager
Ready to Install
Setup is now ready to begin installing mGuard Device Manager on your computer.
mGuard
device manager
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
C:\Program Files\mGuard Device Manager
Setup type:
Custom installation
Selected components:
mdm Server and mdm Client (mandatory)
Java Runtime Environment (JRE)
PostgreSQL Database Server
mdm Service Launcher
Apache Web Server
mdm Certification Authority (optional)
Visit homepage
< Back
Install
Cancel

The mdm components will be installed on the system. After the installation has finished, the locations served through the Apache web server will be reported. mdm is now ready to be used.

If you use the installer program, the following chapters describing the manual installation procedure do not apply. You can skip to Chapter 2.9.

2.4 Manual installation of the mdm client, the mdm server and the database

This section describes how to install mGuard device manager manually. Prior to the installation please make sure that your system fulfills the system requirements (see Chapter 2.1).

Client-server communication

mdm is a client-server application, i.e. the communication path between the client and the server must not be blocked by a firewall or a NAT device. In case you are using a NAT router in your environment, configure your environment in a way that the communication between client and server can proceed.

The *service port* configured in the login window of the client (please refer to Chapter 3.1 and Chapter 2.6) is used to communicate with the mdm server. In a NAT scenario you have to make sure that this port on the server is accessible from the client.

The communication between client and server is encrypted using the SSL protocol.

Communication between mdm and mGuard

The configuration is uploaded from the mdm server to the device using SSH or pulled by the mGuard using HTTPS. Please make sure that the communication between the server and the mGuard is not blocked by a firewall or a NAT device.

2.4.1 Installation on Windows

Required components

For a full installation of mdm you need the following files and components:

- Java Runtime Environment JRE SE 7
- PostgreSQL installation files: *postgresql-9.1.9.zip*
- mdm server: *mdm-server-1.6.x.zip*
- mdm client: *mdm-client-1.6.x.zip*
- License file: *mdm_license.dat*
- mdm-CA: *mdm-ca-1.6.x.zip* (optional)
- OpenSSL (optional)

Except for the license file, these components are contained on the mdm CD-ROM.

Database installation

Install the PostgreSQL database first. PostgreSQL is distributed with an installer for *Windows*. Please follow the instructions of the PostgreSQL-installer. The mdm server and the database can be be installed on different computers.

☞ PostgreSQL can only be installed using an account with administrative privileges. But the PostgreSQL service has to run with non-administrative privileges. For this purpose please create an appropriate account, use one of the existing accounts, or let the PostgreSQL installer automatically create an account for you (install option).

☞ During the installation this account will get the “Log on as a service” permission.

If the access rights of the drive onto which you are planning to install or upgrade the PostgreSQL database are limited to special groups only, ensure that the Windows Users group has also the following access rights to this drive:

- Read
- Read & Execute
- List Folder Contents

These access rights are only required temporarily during the installation process and can be removed once the installation has been completed. If these access rights are not set prior to installation, then the installation process will fail to complete and display the error message:

```
Failed to run initdb: 1!
```

To check or set access rights for a drive/folder:

1. In Windows Explorer, right-click on the drive you are checking.
2. Select **Properties** from the right-click menu.
3. In the *Properties* window, click on the *Security* tab. If this tab is not present, then you have to disable the simple file sharing:
   a.Click **Start**, and then click **My Computer**.
   b.On the Tools menu, click **Folder Options**, and then click the **View** tab.
   c.In the Advanced Settings section, clear the **Use simple file sharing (Recommended)** check box.
4. Select the Users group or the user from the list. The current access rights for the Users group or the user will be displayed in the bottom half of the dialog box. If the Users group is not listed, click on the **Add...** button to add it.
5. Make any necessary changes, then click **Apply**.

Use the following options for the installation:

- If you would like to get error and system messages in a language other than English, please select **National Language Support** in the *Installation Options* as additional package to be installed.
- In the *Service configuration* please enter the login information of the account to be used for PostgreSQL. If you have not yet created an account and you would not like to use an existing account, the installer can also create an account for you.
- Please confirm to grant the permission **Log in as a service**.
- If the mdm server and PostgreSQL are to be installed on different computers, please select the option **Accept connections on all addresses, not just localhost** in **Initialize database cluster**.
  Please enter a password for the internal database superuser, to prevent unauthorized access to the database.
- Accept the default settings in the following windows and start the installation process.

Here are some common recommendations, in case you encounter problems during the installation. They were copied from the “Running & Installing PostgreSQL On Native Windows FAQ”, which can be found at:
http://wiki.postgresql.org/wiki/Running_%26_Installing_PostgreSQL_On_Native_Windows
In case the following hints cannot solve your problems, please check the FAQ for more detailed information.

- ☞ If you cannot install PostgreSQL using mstsc, use
  `mstsc /console`
  (You cannot use a Terminal Server console to install PostgreSQL, but only a local console.)
- ☞ If you decide to create the user account to run the PostgreSQL service manually, make sure that the account has **Log on as a service** and **Log on locally rights**. The **Log on locally** is only required for the install part, and can be removed once the installation is completed if security policies require it. (Rights are granted and revoked using the *Local Security Policy* MMC snapin. **Log on locally** is default, and **Log on as a service** will normally be granted automatically by the installer). Note that if your computer is a member of a domain, the settings of the security policies may be controlled at the domain level using Group Policy.
- ☞ Make sure that the specific postgres account has the correct access rights for the PostgreSQL installation directory:
  The PostgreSQL service account needs read permissions on all directories leading up to the service directory. It needs write permissions on the *data* directory only. Specifically, it should not be granted anything other than read permissions on the directories containing binary files. (All directories below the installation directory are set by the installer, so unless you change something, there should be no problem with this).
  PostgreSQL also needs read permissions on system DLL files like kernel32.dll and user32.dll (among others), which is normally granted by default, and on the CMD.EXE binary, which may in some scenarios be locked down and need opening.

PostgreSQL initialization

After the installation the database has to be created and initialized:

1. To initialize the database, start *pgAdmin III* (*All programs » PostgreSQL 90/pgAdmin III)* which has been installed with PostgreSQL.
2. Connect to the database by opening the context menu in the menu tree on the

left and by selecting **Connect**.

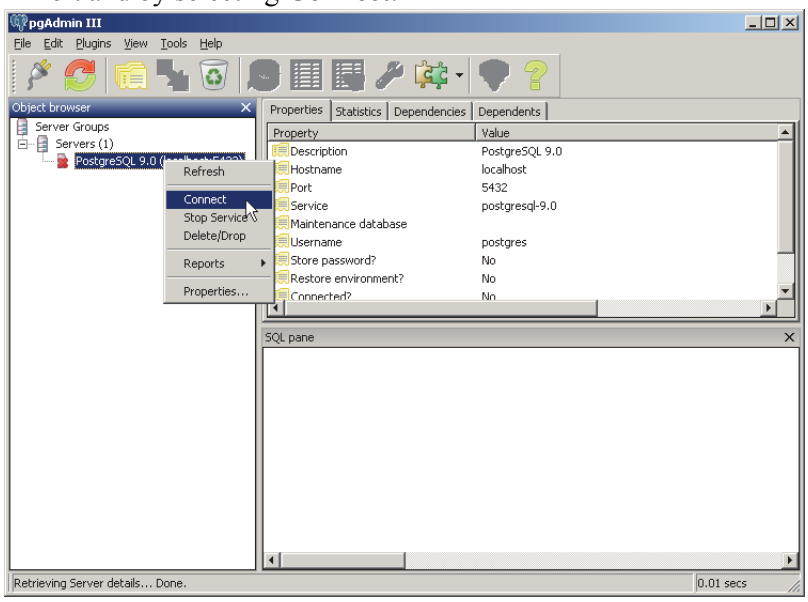


Figure 1: Connecting to the PostgreSQL database with pgAdmin III

3. Enter your login data.

Figure 2: Login to the PostgreSQL database with pgAdmin III

4. Create a new login role by selecting **New login role** from the context menu. Please make sure that the values *your_user* and *your_password* are identical to the values specified in the preference file of the mdm server (see Chapter 2.6):
    - User: *your_user*
    - Password: *your_password*

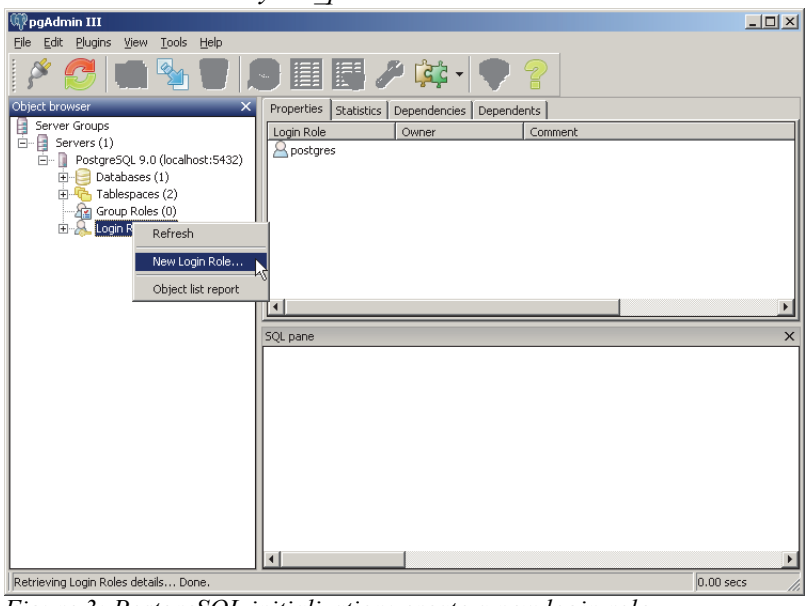


Figure 3: PostgreSQL initialization: create a new login role

5. Select the rights:
    - *Inherits rights ...*

in the tab **Properties**
and select the option

- *With admin option*

in the tab **Role memberships**.

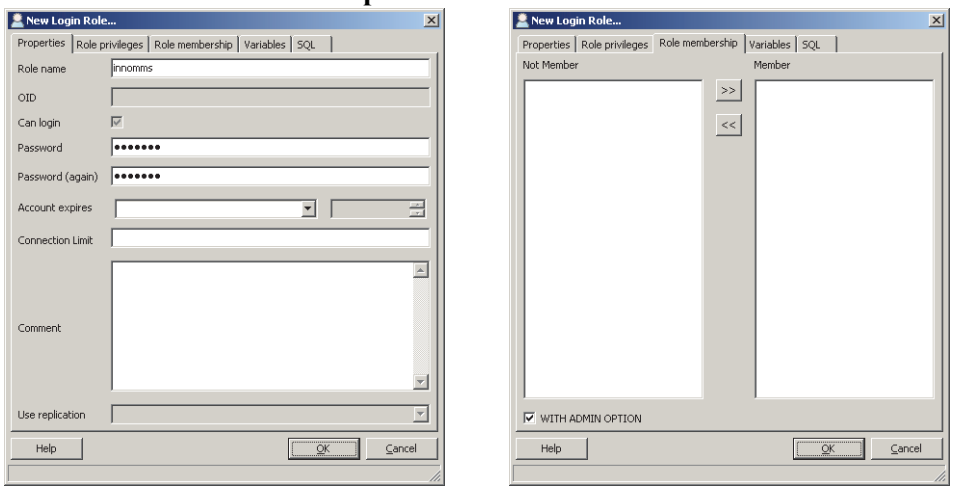


Figure 4: PostgreSQL installation: Configure the new login role

6. Create a database by selecting **New database** in the context menu:

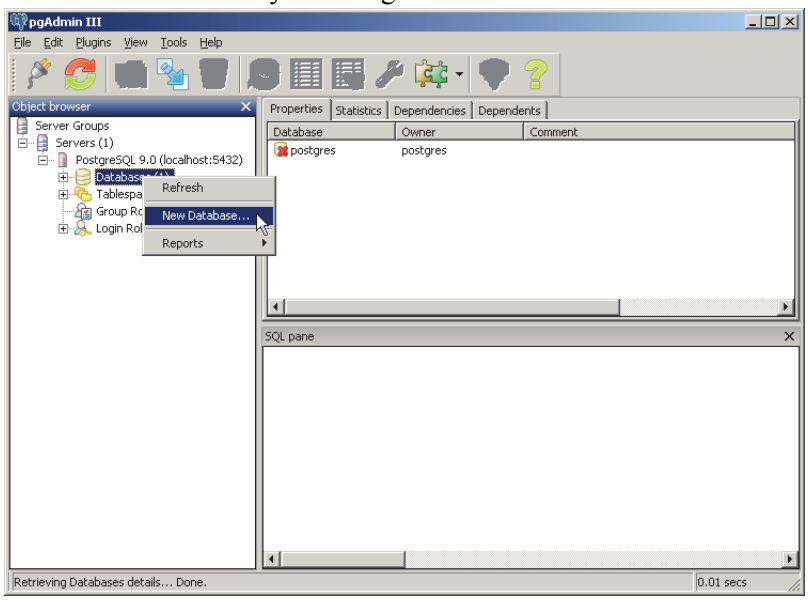


Figure 5: PostgreSQL installation: Create a new database

7. Enter *your_user* as owner and *your_database_name* as name, set the *Encoding* to *UTF-8,* grant all privileges, and close the dialog by clicking on **OK**. Make sure that the values *your_user* and *your_database_name* are identical to the values specified in the preference file of the mdm server (see

Chapter 2.6).

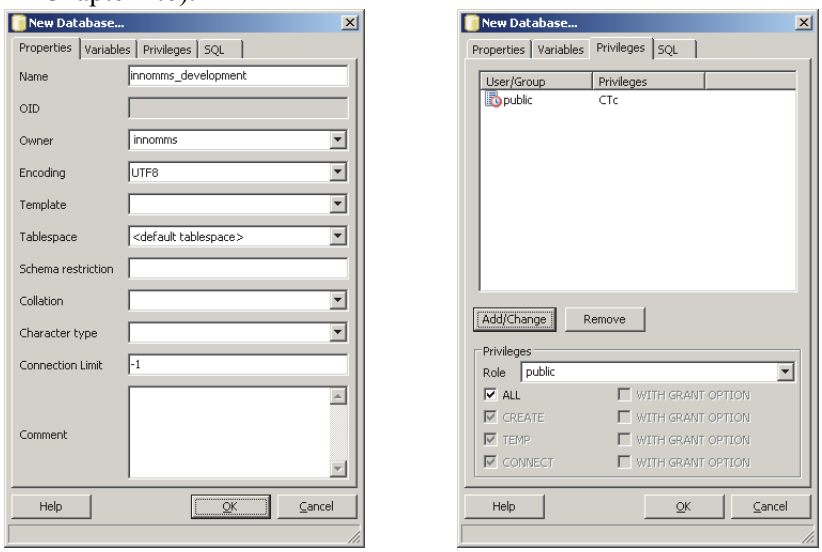


Figure 6: PostgreSQL installation: Configure the new database

Securing the communication with the database

If you install the database and the mdm server or the mdm CA on differerent computers it is highly recommended to encrypt the communication between the components. Please refer to Chapter 2.11 on how to setup a secure connection to the database server.

Server installation

Create a directory *Innominate* in your standard software installation directory (e.g.: *C:\Program Files\Innominate*) and unpack the file *mdm-server-1.6.x.zip* into that directory.

Complete the server installation by configuring the server (Chapter 2.6) and by creating entries in the registry if you would like to start the server automatically (Chapter 2.7).

Finally initialize the database: Make sure that the preferences file matches the values you used when installing the database. To initialize the database you have to start the mdm server with the *init* option:

```
java -Xmx512m -jar mdm-server-1.6.x.jar init preferences.xml
```

Remarks:

- You have to add the full path for *mdm-server-1.6.x.jar* and *preferences.xml*.
- Make sure that the environment variables containing passwords are initialized (see Chapter 2.6).

Client installation

Create a directory *Innominate* in your standard software installation directory (e.g.: *C:\Program Files\Innominate*) and unpack the file *mdm-client-1.6.x.zip* into that directory.

2.4.2 Installation on Linux

Required components

For a full installation of mdm you need the following files and components:

- Java Runtime Environment JRE SE 7
- PostgreSQL installation files: *postgresql-9.1.9.zip*
- mdm server: *mdm-server-1.6.x.zip*
- mdm client: *mdm-client-1.6.x.zip*
- License file: *mdm_license.dat*
- mdm-CA: *mdm-ca-1.6.x.zip* (optional)
- OpenSSL (optional)

Except for the license file, these components are contained on the mdm CD-ROM.

Database installation

Please install the PostgreSQL database first. Choose the installation method that is suitable for your distribution, e.g. for *Debian* use *aptitude* or *Synaptic*. You will also find installation packages for *Fedora* and *Red Hat* on *www.postgresql.org*.

PostgreSQL initialization

After the installation of PostgreSQL the mdm database has to be created and initialized.

1. If the mdm server and the database will not be installed on the same computer, add the following line to the configuration file *pg_hba.conf* in the PostgreSQL directory (e.g. for Debian:*/etc/postgresql/9.0/main)*:
   host your_database_name your_user 0.0.0.0 0.0.0.0 md5
   Please make sure that the values *your_database_name* and *your_user* are identical to the values specified in the preference file of the mdm server (see Chapter 2.6).
2. Restart the PostgreSQL service:
   `/etc/init.d/postgresql-9.0 restart`
3. Enter the following commands (in a single line each) as superuser. Make sure that the values *your_user*, *your_database_name*, *your_password* are identical to the values specified in the preference file of the mdm server (see Chapter 2.6):
   - `su postgres`
   - `createdb your_database_name`
   - `createuser --no-adduser --no-createdb your_user`
   - `echo "ALTER USER \"your_user\" WITH PASSWORD 'your_password' ;" | psql your_database_name`
   - `echo "GRANT ALL ON DATABASE \"your_database_name\" TO \"your_user\" ;" | psql your_database_name`

Securing the communication with the database

If you install the database and the mdm server or the mdm CA on different computers it is highly recommended to encrypt the communication between the components. Please refer to Chapter 2.11 on how to setup a secure connection to the database server.

Server installation

First create a new user, e.g. *mdm*.

Unpack the file *mdm-server-1.6.x.zip* into the home directory of the user *mdm*.

If you would like to start the server when the system is started, please include a script in the */etc/init.d* directory. It is also necessary to create symbolic links in system specific directories; please consult the documentation of your Linux distribution for details.

The SQL database and the mdm server can be installed on different computers.

Finally initialize the database:

Make sure that the preferences file matches the values you used when installing the database. To initialize the database you have to start the mdm server with the *init* option. Enter the following command in a single line:

☞ `java -Xmx512m -jar mdm-server-1.6.x.jar init preferences.xml`

Remarks:

- You have to add the full path for *mdm-server-1.6.x.jar* and *preferences.xml*.
- Make sure that the environment variables containing passwords are initialized with the correct values (see Chapter 2.6).

Client installation Unpack the file *mdm-client-1.6.x.zip* into your home directory.

2.5 Installation of the license

Copy the license file to a folder of your choice and configure the path in the *preferences.xml* file (see next chapter). If you do not specify a path for the license file in the *preferences.xml* file, mdm assumes the license file to be in the same directory as the mdm server. Install the license file prior to the start of the server.

2.6 mdm server configuration

In order to operate properly, the server requires an XML preferences file as a configuration file, which can be specified during server start-up (see Chapter 2.7).
A default configuration file (*preferences.xml*) is contained in the *mdm-server-1.6.x.zip* file. Please unpack the ZIP file to get access to the *preferences.xml* file.

☞ There are several passwords to be configured in the *preferences.xml* file. The respective keys accept the *ENV:VARNAME* pattern as value to take the password from the environment variable with name *VARNAME*. If you decide to use this pattern, please make sure that the respective environment variables are initialized *before* starting the server.

The entries in the preferences file are:

Key *expertMode*
If set to *true*, some unsupported configuration variables which are normally hidden are made available in the *Device* and *Template Properties Dialog* (default: *false*). Additionally, the mGuards are configured such that unsupported configuration variables become visible in their web interfaces. Please do not change this value.

Key *defaultAdminPassword*
The password of the *admin* user on newly created mGuards (default: *mGuard*). The default value corresponds to the mGuard factory default. If mGuard devices are per-configured before they are used with mdm, a different default *admin* password can be set.

Key *defaultRootPassword*
The password of the *root* user on newly created mGuards (default: *root*). The default value corresponds to the mGuard factory default. If mGuard devices are per-configured before they are used with mdm, a different default *root* password can be set.

Node *license*

Key *licenseFile*
Name and path of the license file.

Node *device*

Node *licenseServer*

Key *proto*
The protocol to be used to access the license server (default: *http*). Please do not change this value.

Key *address*
The address of the license server (default: *online.license.innominate.com*). Please do not change this value.

Key *port*
The port to be used to access the license server (default: *80*). Please do not change this value.

Key *reqPage*
The CGI script to be called when requesting licenses (default: *cgi-bin/autoreq.cgi*). Please do not change this value.

Key *refPage*
The CGI script to be called when refreshing licenses (default: *cgi-bin/autorefresh.cgi*). Please do not change this value.

Key *reqProfKey*
The CGI script to be called when requesting profile keys (default: *cgi-bin/autodevcert.cgi*). Please do not change this value.

Key *reqUsername*
The username needed to request profile keys. Please contact Innominate support to obtain a username.

Key *reqPassword*
The password needed to request profile keys. Please contact Innominate support to obtain a username.

Key *retries*
The number of retries to contact the license server (default: *3*). Please do not change this value.

Key *timeout*
The timeout in seconds when contacting the license server (default: *60*). Please do not change this value.

Node *connection*

Key *useProxy*
Here you can configure whether a proxy should be used to contact the license server (default: *false*).

Key *proxyAddress*
The address of the proxy to contact the license server (default: *127.0.0.1*).

Key *proxyPort*
The port of the proxy to be used to access the license server (default: *3128*).

Key *proxyRequiresAuthentication*
Boolean defining whether the proxy requires authentication (default: *false*).

Key *proxyAuthenticationUsername*
Key *proxyAuthenticationPassword*
Key *proxyAuthenticationRealm*
The credentials to be used if the proxy requires authentication (default: empty).

Node *service*

Key *address*
The IP address designating the network interface on which the server is listening for client connections. If you specify *0.0.0.0,* the server is listening on all interfaces (default: *127.0.0.1*).

Key *port*
The port number on which the server is listening for client connections (default: *7001*).

Key *backlog*
Number of log entries to be stored (default: *50*).

Key *storage*
The storage to be used (default: *database*).

Node *security*

Key *keyStore*
Name and path of the keystore file (see Chapter 2.11.1 and Chapter 2.8).

Key *keyStoreType*
Format of the keystore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *keyStorePassword*
Password for the keystore file (see Chapter 2.11.1 and Chapter 2.8). The special value *ENV:PASSWORD_SSL* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_SSL*; the name *PASSWORD_SSL* is just an example and can be changed if desired.

Key *trustStore*
Name and path of the truststore file (see Chapter 2.11.2 and Chapter 2.8).

Key *trustStoreType*
Format of the truststore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *trustStorePassword*
Password for the truststore file (see Chapter 2.11.2 and Chapter 2.8). The special value *ENV:PASSWORD_SSL* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_SSL*; the name *PASSWORD_SSL* is just an example and can be changed if desired.

Node *session*

Key *maxInactiveInterval*
The maximum time interval of inactivity (in seconds) that the server will keep a session open between client accesses.
A negative or zero time (default) indicates a session should never time out.

☞ Please note that this timeout will be reset only, if there is an interaction between client and server. Actions that are local to the client, i.e. scrolling in a table or changing between the device, template, pool, or VPN group tab will not reset the inactive timeout.

Key *maxConcurrentSessions*
The maximum number of concurrent sessions (= connected clients). A negative or zero count (default) indicates that the upper limit of the number of concurrent sessions is defined by the license.

Node *storage*

Node *database*

Key *host*
The IP address (or host name) mdm should connect to to get access to the PostgreSQL database (default: *127.0.0.1*).

Key *port*
The port that mdm should use to connect to the database (default: *5432*).

Key *name*
The name of the database (default: *innomms*).

Key *user*
The user of the database (default: *innomms).*

Key *password*
The password to be used to connect to the database (default: *ENV:PASSWORD_DB).*The special value *ENV:PASSWORD_DB* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_DB*; the name *PASSWORD_DB* is just an example and can be changed if desired.

☞ Please make sure that the values for *port*, *name*, *user* and *password* match the values you specified during the PostgreSQL installation.

Key *ssl*
Enable/disable secure connection between the mdm server and the PostgreSQL server. Please note that enabling this option requires additional installation steps, see Chapter 2.11 (default: *false).*

Node *update*

Node *scheduler*

Key *tries*
Maximum number of attempts for an upload or export of a device configuration. If this maximum is reached, mdm will stop trying to upload a configuation to the device (default: *5*).

Key *timeout*
Maximum number of seconds until an upload of the device configuration is cancelled. After the timeout is reached, mdm will stop trying to upload a configuation to the device (default: *600*).

Key *rescheduleDelay*
Number of seconds between upload attempts (default: *45*).

Node *firmwareUpgradeScheduler*

Key *tries*
Maximum number of connections mdm should attempt to get feedback from the device on the result of the firmware upgrade. If

this maximum is reached, mdm will stop trying to contact the device (default: *5*).

Key *timeout*
Maximum number of seconds until mdm stops to contact a device for the result of a firmware upgrade. After the timeout is reached, mdm will indicate that the firmware upgrade failed (default: *3600*).
Key *rescheduleDelay*
Intervall in seconds between two attempts to obtain the result of a firmware upgrade from the device (default: *300*).

Node *ssh*

Key *connectTimeout*
Timeout for the initial SSH connect to a device (default: *60*).

Key *socketTimeout*
Timeout for the SSH connection TCP/IP socket, e.g. lost connection (default: *120*).

Key *deadPeerDetectionTimeout*
This timeout will get activated, if a device did not answer a command started on the device (default: *120*).

Node *pull*

Node *export*

Key *directory*
The export base directory on the server where the configuration files should be exported to (e.g. for the configuration pull). Please note that the configuration files are always exported by the server and not the client, i.e. the client does not have any access to the files. The specified directory pathname should have the appropriate format of the respective OS (default: the default temporary directory of your installation, e.g. /*tmp* for Linux).

Key *filenames*
A comma-separated list of naming schemes for pull configuration exports.
dbid: A unique ID (automatically assigned) is used as filename and the files are written to the export base directory.
serial: The serial number is used as filename and the files are written to the *serial/* subdirectory of the export base directory.
mgntid: The Management ID is used as filename and the files are written to the *mgntid/* subdirectory of the export base directory (default: *dbid,serial,mgntid*).

Node *feedback*

Key *port*
The mGuards can pull their configurations from an HTTPS server. Since the HTTPS server is a separate application, mdm does not get any direct feedback about the result of a configuration pull. To enable the feedback mechanism, mdm has to be configured as a Syslog server in the HTTPS server settings. mdm will then receive and analyze the HTTS server

syslog messages and display the result of configuration pulls in the client.
It is recommend to use an unprivileged port (above 1024) so that the server can be run without administrator/root privileges (default: *7514*).

Node *service*

Node *radius*

Key *numServers*
Set this to the number of RADIUS servers to enable RADIUS authentication. Please refer to Chapter 3.11.4 for more detailed information. If set to *0*, RADIUS authentication is disabled (default: *0*).

Key *timeout*
The number of seconds that the mdm server waits for a reply from a RADIUS server. Only used if RADIUS authentication is enabled (default: *5*).

Key *retries*
The number of times that the mdm server sends requests to the RADIUS servers. If no reply is received within ***timeout*** seconds for ***retries*** times, the authentication request is considered failed. Only used if RADIUS authentication is enabled (default: *3*).

Key *nasIdentifier*
The NAS Identifier included in RADIUS requests sent by the mdm server. Some RADIUS servers ignore this, in which case the default value can be left unchanged (default: *nas.identifier.example*).

Nodes *0*, *1*, … (up to the number of RADIUS servers minus one)
Each numbered node identifies a single RADIUS server.

Key *host*
The hostname or IP address of the RADIUS server (default: *localhost*).

Key *port*
The port on which the RADIUS server listens for incoming requests (default: *1812*).

Key *sharedSecret*
The shared secret used to authenticate the RADIUS request. The same shared secret must be configured in the RADIUS server (default: *secret*).

Node *locale*

Country and language specific settings. Please leave the defaults, since these settings are not fully supported yet.

Node *logging*

Node *syslog*

Key *numReceivers*
Set this to the number of syslog receivers to which mdm sends log messages. If set to *0*, logging via syslog is disabled (default: *1*).

Key *logLevel*
The minimum severity of the messages to log via syslog. Messages with a severity lower than the specified one are suppressed (default: *INFO*).

The following severities can be used:

- *SEVERE* (highest severity)
- *WARNING*
- *INFO*
- *CONFIG*
- *FINE*
- *FINER*
- *FINEST* (lowest severity)

Nodes *0*, *1*, … (up to the number of syslog servers minus one)
Each numbered node identifies a single syslog server.

Key *host*
The hostname or IP address of the syslog server (default: *localhost*).

Key *port*
The port on which the syslog server listens for incoming log messages (default: *514*).

Node *configurationHistory*

Key *expireAfterDays*
Configuration history entries older than the specified number of days are automatically expired (i.e. removed from the history). If the value *0* is used, configuration history entries are never expired (default: *14*).
Please refer to Chapter 6 for more detailed information on configuration history entries.

Node *CA*

These settings are required only if a CA is used.

Key *type*
The type of CA to use. Valid values are *mdm-CA* to use the mdm CA or *SCEP* to communicate with a CA via SCEP (default: *mdm-CA*). Please refer to Chapter 4.6.1 for more detailed information on SCEP.

Key *protocol*
The protocol to be used to connect to the mdm CA. Valid values are *http* or *https* (default: *https*). When using the mdm CA, only *https* should be used since the mdm CA relies on transport layer security for authentication purposes. SCEP includes application layer authentication mechanisms, so *http* is usually used with SCEP.

Key *host*
The hostname or IP address of the CA server (default: *localhost*).

Key *port*
The port on which the CA server listens for incoming requests (default: *7070*). If *0* is specified, the *https* or *http* default port is used.

Key *requestDirectory*
The path within the URL the mdm server uses for certification requests (default: *request*). When using the mdm CA, *request* must be used. When using SCEP, consult the documentation of the CA server. If e.g. the Microsoft Windows Server 2008 CA is used, *CertSrv/mscep/mscep.dll* should be specified.

Key *revocationDirectory*
The path within the URL the mdm server uses for certificate revocation requests (default: *revoke*). When using the mdm CA, *revoke* must be used. Not applicable when SCEP is used.

Key *rsaKeySize*
The size (in bits) of the RSA modulus the mdm server uses to generate RSA key pairs (default: *2048*).

Node *SCEP*

Key *name*
The instance name used in SCEP requests (default: *mdm*). Please note that some CAs ignore the instance name, but still require a non-empty value.

2.7 Start the mdm server and the mdm client

☞ To configure the mdm server a preferences file is required. A standard preferences file (*preferences.xml*) is contained in the *mdm-server-1.6.x.zip* file. Please unpack the ZIP file to get access to the *preferences.xml* file.

☞ In general the server is started with the following command (in a single line):

```
java -Xmx1024m -jar mdm-server-1.6.x.jar start
preferences.xml
```

Remarks:

- You have to add the full path for *mdm-server-1.6.x.jar* and *preferences.xml*.
- Make sure that the environment variables containing passwords are initialized (see Chapter 2.6).

Memory allocation

You should also specify the size of the memory allocation pool using the *-Xmx* and *-Xms* options.

Initial size of the memory allocation pool

Use the option *-Xms to* specify the *initial size*, in bytes, of the memory allocation pool. This value must be a multiple of 1024. Append the letter *k* or *K* to indicate kilobytes, or *m* or *M* to indicate megabytes. The default value is 2 MB. Examples:

```
-Xms33554432
-Xms32768k
-Xms32m
```

Maximum size of the memory allocation pool

Use the option *-Xmx* to specify the *maximum size*, in bytes, of the memory allocation pool. This value must be a multiple of 1024. Append the letter *k* or *K* to indicate kilobytes, or *m* or *M* to indicate megabytes. The default value is 64 MB. Examples:

```
-Xmx268435456
-Xmx262144k
-Xmx256m
```

☞ For the client a value of 512 MB (`-Xmx512m`) is recommended, especially if mdm is used to configure VPN connections.

☞ The server should generally have as much memory as possible, so that it can make efficient use of its caching mechanisms, but not so much that the machine starts swapping. Recommended is a value between 50% and 75% of the physical RAM size, depending on which other applications are running on the same machine.

Windows

Server

In case you would like to start the server as a service, two tools from the Windows Resource Kit (can be downloaded from www.microsoft.com) are required:

- srvany.exe
- instsrv.exe

Please download and install the Windows Resource Kit.
The required installation steps for running the mdm Server as Windows service are:

1. Execute the command:
   `instsrv <Service name> <Path to srvany.exe>`
   e.g.: `instsrv mdm_Server_1.6 c:\ntreskit\srvany.exe`

2. Open the registry editor and navigate to the key:
   `HEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\<Service name>`
   e.g. `HEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\mdm_Server_1.6`

3. Create a new key called *Parameters.*
4. Beneath *Parameters*, create the following three REG_SZ entries:
   Application, AppDirectory, AppParameters

5. Assign the following values to the entries:
   `Application = <Full path to java.exe>`
   e.g. `Application=C:\Program Files\Java\jre7\bin\java.exe`

   `AppDirectory = <Path in which mdm-server-1.6.x.jar is located>`
   e.g. `AppDirectory=C:\Program Files\Innominate\mdm\Server`

   `AppParameters=<application arguments>`
   e.g. `AppParameters=-Xmx1024m -jar C:\Program Files\Innominate\mdm\Server\mdm-server-1.6.x.jar start c:\Inno\mdm\preferences.xml`

6. To start the service from the command line, execute:
   `net start <Service name>`
   e.g. `net start mdm_Server_1.6`
   ☞ The service appears to be running if the the “wrapper service” *srvany* has been started successfully. It could therefore be possible that the mdm server has not been started, even if the service is running.

7. To stop the service from the command line, execute:
   `net stop <Service name>`
   e.g. `net stop mdm_Server_1.6`

8. To remove the service, execute:
   `instsrv <Service name> remove`
   e.g. `instsrv mdm_Server_1.6 remove`

If you would like to run the server as an application, but start it automatically with the login, add the following *REG_SZ* value to the `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run` folder of your registry:

name: `mdm_Server`
value: `"full_path\\java.exe" -Xmx1024m -jar full_path\mdm-server-1.6.x.jar start full_path\preferences.xml`
e.g.:

```
"C:\\Program Files\\Java\\jre7\\bin\\java.exe" -Xmx1024m
    -jar C:\Program Files\Innominate\mdm-server-1.6.x.jar
    start C:\Program Files\Innominate\preferences.xml
```

Client

You can start the client either with the command line:

full_path\java `-Xmx384m` -jar mdm-client-1.6.x.jar

or with a double-click on *mdm-client-1.6.x.jar* in the Explorer-Window.

Linux

Server

The server can be started manually with the command (in a single line):

```
full_path/java -Xmx1024m
-jar full_path/mdm-server-1.6.x.jar start
full_path/preferences.xml
```

Client

You can start the client by entering the command:

```
full_path/java -Xmx384m -jar mdm-client-1.6.x.jar
```

2.8 mdm Certification Authority (CA) installation

mdm provides its own Certification Authority (CA). The mdm CA is a separate server instance. The CA is used to issue machine certificates for the mGuards, e.g. if you would like to use X.509 authentication for your VPN tunnels. Please refer to Chapter 4.5 on how to request certificates for an mGuard using the CA.

If you are not going to configure VPN tunnels with mdm or if you would like to use your own CA or pre-shared keys (PSK), the installation of the mdm-CA is not required.

2.8.1 Overview

The purpose of the mdm CA is to issue certificates, which are requested by the mdm server to be used as machine certificates for mGuards.

The mdm CA is implemented as a stand alone server. Its interface to the mdm server is a servlet driven web server (HTTP), which can be secured with SSL (HTTPS) and which can enforce client authentication. Especially in production environments Innominate highly recommends to use HTTPS with client authentication, because only then is it assured that the mdm CA will issue certificates to authenticated clients only.

The configuration file of the mdm CA server allows to configure different keystores (isolation) for the generation of certificates (CA-keystore) and for the SSL authentication (SSL-keystore, SSL-truststore). This assures that the CA private key (intended for issuing machine certificates) is not accidentally used for SSL authentication.

The mdm CA stores all required information in a PostgreSQL database. The communication between the mdm CA and the database should be also secured using SSL.

All the required keys and certificates to secure the communication between mdm CA, mdm server and the database have to be generated, installed in the file system and configured in the *ca-preferences.xml* file of the CA component and also in the *preferences.xml* file of the mdm server.

There are many tools to create and manage keys and certificates. This document describes the usage of the *OpenSSL* tools, which are available for Linux and Windows (e.g. as stand-alone binary or as part of the *cygwin* package). The tools to create the certificates, keys, and keystores need not be installed on the mdm CA target system.

☞ The use of OpenSSL 0.9.8zc, 1.0.0o or 1.0.1j or newer is recommended, due to the support of SHA-256 and several important security fixes.

☞ Certificate Revocation Lists (CRLs) are not supported by mGuard 4.2, but are supported with mGuard firmware 5.0 and newer. If using mGuard 4.2 it is recommended to include the CRL distribution points (CDP) information already in the certificates when rolling out a PKI, since then an exchange of the certificates will not be required when updating to a newer mGuard firmware.

Chapter 2.8.2 contains an overview over the installation procedure.
Chapter 2.8.3 describes how to use the *demoCA* scripts contained in the installation archive *mdm-ca-1.6.x.zip* to create the required keys and certificates.
Chapter 2.8.4 provides detailed information on how to manually create and install the keys and certificates.

2.8.2 Installation procedure

1. Create an OS user for the mdm CA server. The user for the mdm server could be reused though that is not recommended (isolation).
2. Unpack *mdm-ca-1.6.x.zip* into that user's home directory.
3. Make sure the PostgreSQL database 9.0 is installed (see Chapter 2.4). The mdm CA can use the same database instance as the mdm server but for separation of name spaces it is required to create a different database schema (= user) for the CA, e.g. *mdmca*.
4. Create the database schema from scratch analogous to the mdm server but instead of initializing the database using the *init* option of the mdm server use the script *mdmca.sql* from the archive *mdm-ca-1.6.x.zip* (see below).
   For Windows please refer to the section *Database installation* in Chapter 2.4.1. For Linux refer to the section *Database installation* in Chapter 2.4.2.
   To initialize the database schema on Linux please enter the following command in a single line:
   ```
   psql -h 127.0.0.1 -f mdmca.sql your_database_name your_CA_user
   --password
   ```
   To initialize the database schema on Windows please start *pgAdmin III* as described in Chapter 2.4.1. Select the database schema you just created in the previous steps and click on the icon, select **File » Open** in the menu of the query-window, select the mdm initialization script *mdmca.sql* in the file chooser and finally start the query by clicking on the icon in the query window. The database is initialized now.
5. Adapt the *database* node of the *ca-preferences.xml* file (see Chapter 2.8.5) to your environment.
6. Either create the required keys and certificates automatically using the *demoCA* scripts (see Chapter 2.8.3) or follow the instructions in Chapter 2.8.4 (manual creation). After this step the keys, certificates and keystores should be located in your file system.
7. If required, change further keys of the *ca-preferences.xml* file not mentioned in the previous step (for an explanation of all keys refer to Chapter 2.8.5).
8. Start the CA server (see Chapter 2.8.6)

2.8.3 Creation of the keys and certificates using the demoCA scripts

Instead of manually creating the keys and certificates you can also use the scripts provided in the installation archive *mdm-ca-1.6.x.zip*. This chapter describes how to adapt the scripts and configuration files to meet your requirements. If you

prefer to create the certificates and keys manually you can skip this chapter and continue with Chapter 2.8.4. However, if you are interested in detailed information about creating keys and certificates please refer to Chapter 7.

☞ The scripts generate all required keys, keystores and certificates, including the CA certificates and the SSL certificates, i.e. after following the steps described in this chapter the communication paths between the mdm components are already secured (see Chapter 2.11).

☞ If you would like to use an OpenSSL version older than version 0.9.8 you have to change the digest algorithm in the scripts to an algorithm supported by your OpenSSL version. The digest algorithm is configured in the files *set-env.bat*/*set-env.sh*.

Installation

The *demoCA* directory contains scripts to be used with Linux and with Windows. The names of the scripts for the different OS are alike, just the extension differs: *.sh* for Linux and *.bat* for Windows.

The Linux scripts must be made executable before they can be invoked. Change into the *demoCA* directory and type the following command:

```
chmod +x *.sh
```

Contents of the *demoCA* directory

The following files are contained in the *demoCA* directory:

Tools

- *ImportKey.class, ImportKey.java*
  Java tool to create and manage keystores.

General purpose scripts

- *gen-all.bat, gen-all.sh*
  These scripts generate all required keys and certificates.
- *gen-dirs.bat, gen-dirs.sh*
  These scripts create the sub directories in your target directory (see section *Running the scripts* below) in which the certificates and keys are stored.
- *set-env.bat, set-env.sh*
  These scripts contain the initialization of the environment variables that are used in the subsequent scripts.

Scripts to generate the CA certificates

- *gen-template.bat, gen-template.sh*
  Scripts to generate the template certificate.
- *gen-ca.bat, gen-ca.sh*
  Scripts to generate the intermediate CA certificate and keys.
- *gen-root.bat, gen-root.sh*
  Scripts to generate the root CA certificate and keys.

OpenSSL configuration files (to be used for the generation of the CA certificates)

- *caCert.conf*
- *rootCert.conf*
- *templateCert.conf*

Scripts to generate the SSL certificates

- *gen-ssl.bat, gen-ssl.sh*
  Scripts to generate all required SSL certificates.
- *gen-ssl-mdm-ca.bat, gen-ssl-mdm-ca.sh*
  Scripts to generate the mdm CA certificates.
- *gen-ssl-mdm-server.bat, gen-ssl-mdm-server.sh*
  Scripts to generate the mdm server certificates.
- *gen-ssl-postgres.bat, gen-ssl-postgres.sh*
  Scripts to generate the certificates for the PostgreSQL database.

Adapting the scripts

The scripts have to be adapted to your environment:

Default passwords

The passwords in the scripts *set-env.bat,set-env.sh* have to be changed:

```
PASSWORD_ROOT='geheimRoot'
PASSWORD_CA='geheimCA'
PASSWORD_SSL='geheimSSL'
```

Please use your own, secure passwords.

Location of OpenSSL

If you are using Windows, you might have to adapt the installation path for *openssl.exe* in the file *set-env.bat* to your environment.

OpenSSL configuration files

☞ For further information on certificate extensions and on the *Subject Distinguished Name* please refer to Chapter 7.2.

In all three configuration files (*caCert.conf, rootCert.conf, templateCert.conf*) the section which determines the *Subject Distinguished Name* has to be adapted to your environment:

```
C= DE
O= Innominate Security Technologies AG
OU= Research & Development
CN= Test Root CA
```

Furthermore in the extension section of the files *caCert.conf* and *templateCert.conf* the entries `crlDistributionPoints` and `authorityInfoAccess` have to be adapted to your environment:

```
crlDistributionPoints=URI:http://ca.example/ca.crl
authorityInfoAccess=OCSP;URI:http://ca.example/ocsp/ca
```

Running the scripts

The *gen-all* scripts require as argument the target directory, e.g.

```
gen-all my_directory_incl_full_path
```

If a target directory is omitted a subdirectory named *security* will be automatically created in the mdm installation directory. All generated scripts and certificates will be created in subdirectories of the target directory.

Using the output of the scripts

The *gen-all* script creates all required files in the target directory. The location of the files has to be manually configured in the preferences file of the respective mdm component.

☞ The names used for certificates and keys in the following sections refer to the names introduced in Figure 7 and in Chapter 7.2.1.

☞ The preferences files support the construct ENV:*MY_PASSWORD* for passwords, i.e. the password is read from the environment variable *MY_PASSWORD* (the name of the environment variable is just an example and can be changed if desired).

Subdirectory *mdm_ca*

- *ca-keystore.jks*
  A keystore in JKS format containing the certificate chain up to the root certificate (CA_{cert}, $CA_{rootCert}$) and CA_{key}.
  - The filename of this keystore (including the absolute or relative path) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyStore***.
  - The password to access the keystore (default: *ENV:PASSWORD_CA*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyStorePassword***.
  - The format of this keystore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory »***

keyStoreType.
    - The password to access the private key (default: *ENV:PASSWORD_CA*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyPassword.***
    - The alias (default: *ca*) of the key has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyAlias.***
- *https-keystore.jks*
  A keystore containing IC_{cert} and IC_{key} .
    - The full pathname of this keystore has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » keyStore***
    - The format of this keystore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » keyStoreType***
    - The password to access the keystore (default: *ENV:PASSWORD_SSL*) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » keyStorePassword***
- *https-truststore.jks*
  A keystore containing IS_{cert} .
    - The filename including the path of this keystore has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStore***
    - The format of this keystore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStoreType***
    - The password to access the keystore (default: *ENV:PASSWORD_SSL*) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStorePassword***
- *database-truststore.jks*
  A keystore containing DB_{cert}.
    - The location of this keystore has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStore***
    - The format of this keystore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStoreType***
    - The password to access the keystore (default: *ENV:PASSWORD_SSL*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStorePassword***
- *templateCert.pem*
  This file contains $CA_{templCert}$.
  The location of this file has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » certTemplate***

Subdirectory *mdm_server*

- *keystore.jks*
  A keystore containing IS_{cert} and IS_{key} .
    - The location of this keystore has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStore***

    - The format of this keystore (JKS) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStoreType***
    - The password to access the keystore (default: *ENV:PASSWORD_SSL*) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStorePassword***
- *truststore.jks*
  A keystore containing DB_{cert} and IC_{cert}
    - The location of this keystore has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStore***
    - The format of this keystore (JKS) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStoreType***
    - The password to access the keystore (default: *ENV:PASSWORD_SSL*) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStorePassword***

Subdirectory *postgres-server*

- *server.crt*
- *server.key*
  These are the files containing DB_{cert} and DB_{key} . The files have to be copied to the PostgreSQL data directory (i.e. the subdirectory of the PostgreSQL directory usually named *pgdata*).

Subdirectory archive

This directory contains certificates and keys that were created during the process, but are not required for the installation. Please do not delete this directory since it contains e.g. the root key which might be required when signing further intermediate CA certificate requests.

Further keys in the configuration files

To enable the SSL communication the following keys of the configuration files have to be configured as well:

- *ca-preferences.xml*
    - ***certificateFactory » storage » database » ssl = true***
    - ***httpServer » protocol = https***
    - ***httpServer » https » clientAuth = true***
- *preferences.xml*
    - ***server » storage » database » ssl = true***
    - ***ca » protocol = https***

2.8.4 Manual creation of the CA keys and certificates

This section explains how to manually create and install the keys and certificates required for the CA. If you are not familiar with *OpenSSL* it is highly recommended to read Chapter 7 first, which introduces some of the basic concepts and explains the process in detail. The requirements for the certificates are summarized in Chapter 7.2.3.

Follow these steps to manually create the mdm CA keys and certificates:

1. Generate $CA_{rootCert}$ and a matching private key $CA_{rootKey}$ as described in Chapter „Create the root certificate” on page 118.
2. Generate the CA certificate CA_{cert} and the corresponding private key CA_{key} as described in Chapter „Create the CA certificate” on page 120.

3. Generate the template certificate $CA_{templCert}$ as described in Chapter „Create a certificate template” on page 123. The template certificate is used by the CA as template for creating the mGuard certificates.
4. Create the CA keystore and configure the preferences file of the mdm CA as described in Chapter „Create the keystores” on page 125.
5. Secure your communication paths and configure the preferences files of the mdm components as described in Chapter 2.11.

2.8.5 Configuration of the mdm CA

This chapter describes the contents of the configuration file *ca-preferences.xml* contained in the installation archive *mdm-ca-1.6.x.zip.* Please adapt *ca-preferences.xml* according to your environment.

Node *certificateFactory*

Key *validityPeriodDays*
Number of days certificates issued by the mdm CA shall be valid (i.e. each certificate will be valid for the specified number of days starting from the time of its issuance).

Key *certTemplate*
Name and path of a certificate file to be used as template for new VPN certificates issued by the mdm CA.

Key *keyStore*
Name and path of the keystore file (see Chapter 2.11.1 and Chapter 2.8).

Key *keyStoreType*
Format of the keystore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *keyStorePassword*
Password for the keystore file (see Chapter 2.11.1 and Chapter 2.8). The special value *ENV:PASSWORD_CA* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_CA*; the name *PASSWORD_CA* is just an example and can be changed if desired.

Key *keyAlias*
Name of the entry within the keystore, where the private key and associated public key certificate can be found (the keystore may contain more than one entry) - default matches the one from the example scripts described in Chapter 2.8.3. To find out the alias names in a *.p12* file please use the command:

```
openssl pkcs12 -in <filename>.p12 -nodes
```

The alias is shown as *Friendly Name* in the output.
To find out the alias names in a *JKS* file please use the command:

```
keytool -list filename
```

Key *keyPassword*
Password to decrypt the RSA private key contained within the keystore (see entry *keyAlias)*; the special value *ENV:PASSWORD_CA* will cause the mdm CA server to read this password upon startup from the environment variable named *PASSWORD_CA*; the name *PASSWORD_CA* is just an example and can be changed if desired.

Key *crlExportDirectory*
The path to the directory that is used by the mdm CA to export the files containing the CRLs (Certificate Revocation Lists). Each file contains a *PEM* encoded X.509 CRL of revoked certificates from a single issuer. The filename of each CRL file is composed of the hash value of the issuer with a *crl* extension, e.g. *5E84D566026616ED32169580A913661499FA6B03.crl*. Please make sure

that the files contained in this directory are accessible from the mGuards. To configure the CRL URL on the mGuards please navigate to **Authentication » Certificates » CRLs** in the *Device* or *Template Properties Dialog* (mGuard 5.0 or newer only) and add the correct URL to the CRL table. Please refer to Chapter 4.6.1 for more details on certificate revocation (default: *security/crl)*.

Key *crlUpdatePeriodMinutes*
The time interval in minutes how often CRLs are exported to the ***crlExportDirectory***. When a certificate is revoked, a CRL is exported immediately. Additionally, CRLs are exported periodically according to the specified time interval.

Key *nextUpdatePeriodDays*
The number of days into the future written into the *Next Update* field in exported CRLs. The field is a hint for the mGuard downloading the CRL when it is to be considered obsolete. It should therefore be significantly larger than ***crlUpdatePeriodMinutes*** (but note that ***crlUpdatePeriodMinutes*** is specified in minutes, while ***nextUpdatePeriodDays*** is specified in days).

Node *storage*

Node *database*

Key *host*
The IP address (or host name) the mdm CA should connect to to get access to the PostgreSQL database (default: *127.0.0.1*).

Key *port*
The port that the mdm CA should use to connect to the database (default: *5432*).

Key *name*
The name of the database (default: *mdmca*).

Key *user*
The user of the database (default: *mdmca)*.

Key *password*
The password to be used to connect to the database; the default value *ENV:PASSWORD_DB* will cause the mdm CA server to read this password upon startup from the environment variable named *PASSWORD_DB*; the name *PASSWORD_DB* is just an example and can be changed if desired.

☞ Please make sure that the values for *port*, *name*, *user*, and *password* match the values you specified during the database initialization.

Key *ssl*
Enable/disable secure connection between the mdm CA and the PostgreSQL server. Use the value *true* to enable secure connections (see Chapter 2.11.1).

Key *loglevel*
Internal use only. Please do not change (default: *0*).

Node *security*

Key *trustStore*
Name and path of the truststore file containing the trusted certificate of the database server.

Key *trustStoreType*
Format of the truststore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *trustStorePassword*
Password for the truststore file (see Chapter 2.11.2 and Chapter 2.8). The special value *ENV:PASSWORD_SSL* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_SSL*; the name *PASSWORD_SSL* is just an example and can be changed if desired.

Node *certificationRequestHandler*

Key *maxRequestLength*
Number of bytes *PKCS#10* certification requests can have at most; longer requests will be rejected to defend against simple DoS attacks (default: *102400*).

Node *revocationRequestHandler*

Key *maxRequestLength*
Number of bytes revocation requests must have at most; longer requests will be rejected to defend against simple DoS attacks (default: *10240*).

Node *httpServer*

Key *host*

IP address or host name of the interface to listen on with the mdm CA's servlet interface; value *0.0.0.0* means to listen on any interface (default: *127.0.0.1*).

Key *port*
Port number the server should listen on for incoming connections (default: *7070*).

Key *minThreads*
Minimum number of instantiated HTTP server threads the mdm CA shall maintain in its pool (default: *2*).

Key *lowThreads*
Internal use only. Please do not change.

Key *maxThreads*
Maximum number of instantiated HTTP server threads the mdm CA shall keep in its pool (default: *5*).

Key *protocol*
The protocol the mdm CA's servlet interface should use; either *http* or *https.* To enable secure communication, *https* should be used.

Node *https*
The configuration in this node is used only if ***protocol*** in node ***httpServer*** is *https*.

Key *keyStore*
Name and path of the keystore file.

Key *keyStoreType*
Format of the keystore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *keyStorePassword*
Password for the keystore file. The special value *ENV:PASSWORD_SSL* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_SSL*; the name *PASSWORD_SSL* is just an example and can be changed if desired.

Key *keyPassword*
The password required to decrypt the SSL private key contained in the keystore for the HTTPS server.

Key *clientAuth*
Boolean value; *true* means clients need to authenticate via SSL too (not just the server); *false* means clients do not need to authenticate. This value should be set to *true*.

Key *trustStore*
Name and path of the truststore file containing the trusted certificates for the SSL connection from the clients.

Key *trustStoreType*
Format of the truststore, either *JKS* (Java JRE keytool, default) or *PKCS12* (OpenSSL).

Key *trustStorePassword*
Password for the truststore file (see Chapter 2.11.2 and Chapter 2.8). The special value *ENV:PASSWORD_SSL* will cause the mdm server to read this password upon startup from the environment variable named *PASSWORD_SSL*; the name *PASSWORD_SSL* is just an example and can be changed if desired.

Node *logging*

Key *file*
The base name of the rotated log file the mdm CA will produce; the file name may be used with a relative or absolute path name. The suffix *n.log* will be appended to the base name, with *n* being a non-negative integer.

Key *limit*
Maximum number of bytes a log file of the mdm CA can reach; when it grows beyond this number, it will be rotated.

Key *count*
Maximum number of rotated log files the mdm CA should keep.

Key *level*
Defines granularity of the logging messages the mdm CA will produce; acceptable values are:
- *OFF*
- *SEVERE* (highest value)
- *WARNING*
- *INFO*
- *CONFIG*
- *FINE*
- *FINER*
- *FINEST* (lowest value)
- *ALL*

2.8.6 Starting the CA

Start the CA with the following command in a single line (please note that the CA has its own preferences file *ca-preferences.xml*, as described above):

```
java -Xmx384m -jar full_path/mdm-ca-1.6.x.jar
full_path/ca-preferences.xml
```

☞ Prior to starting the CA you should set the environment variables that contain the passwords:

```
PASSWORD_CA='your_CA_password'
PASSWORD_SSL='your_SSL_password'
PASSWORD_DB='your_DB_password'
```

☞ Depending on your settings for the keys in the *ca-preferences.xml,* different environment variables than the examples above need to be used.

2.9 Pre-configuration of the mGuards

Please follow the steps described in the *Reference Manual mGuard Appliances* for starting up and configuring the device (IP addresses of the interfaces etc.).

Enable SSH access

The mdm installs the configuration files on the mGuards using SSH. Therefore SSH access has to be permitted on the mGuards if mdm is using the external (untrusted) interface to upload the configuration.

Select **Management » System settings » Shell access** in the menu of the Web user interface and enable SSH remote access. For more detailed information on SSH remote access please consult the *mGuard Reference Manuals*.

☞ If you enable remote SSH access, make sure that you change the default admin and root passwords to secure passwords.

☞ mdm is using the admin password to log into the Innominate mGuard. If the password was changed locally on the device please change the password setting in mdm accordingly using the **Set Current Device Passwords** option in the context menu of the device overview table. Otherwise mdm is not able to log into the device.

☞ The current root password is part of the configuration file. If the password was changed locally on the device please change the password setting in mdm accordingly. Otherwise the mGuard will reject the configuration.

2.10 Installation of an HTTPS configuration pull server

To transmit information on the configuration status of an mGuard, the HTTPS pull server has to send SYSLOG messages to the mdm server (pull feedback). Please make sure that neither the communication between the HTTPS server and the mdm server nor the communication between the HTTPS pull server and the mGuards is blocked by a firewall or a NAT device.

2.11 Securing the communication between mdm components

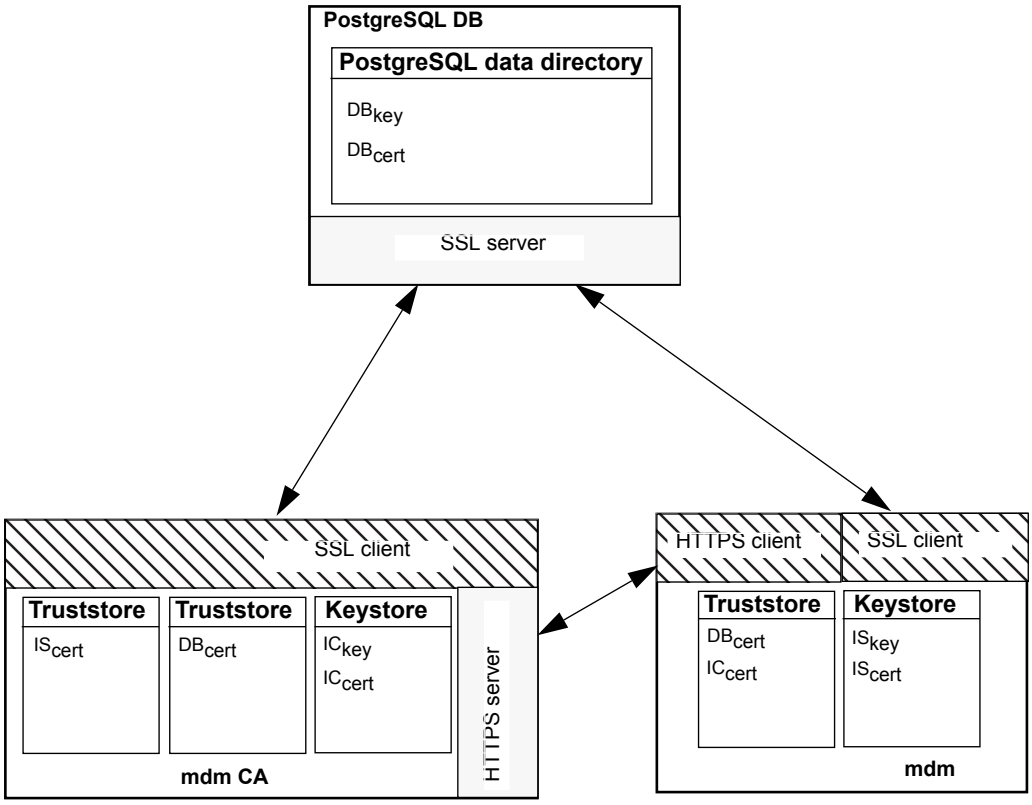
Since critical information is exchanged between the mdm components it is highly recommended to secure the communication paths. This chapter describes the required steps to manually create the keys and certificates required for SSL.

☞ If you prefer to use the *demoCA* scripts, instead of manually creating and installing the required components, you can skip this chapter and read Chapter 2.8.3 instead.

If you are not familiar with *OpenSSL* it is highly recommended to read Chapter 7 first, which introduces some of the basic concepts and the usage of the *OpenSSL* command line tool.

Figure 7 shows an overview over the mdm components and their communication paths.

☞ Please note that the truststore and the keystore of the CA shown in Figure 7 are used for SSL communication only. The certificates and keys used to issue certificates are stored in a different keystore.



IC_{cert}	CA certificate (Important: This is not the root certificate of the CA.)
IC_{key}	Private key of the CA (Important: This is not the key used to sign certificate requests.)
IS_{cert}	mdm server certificate
IS_{key}	Private key of the mdm server
DB_{cert}	DB server certificate
DB_{key}	Private key of the DB server

Figure 7: Communication paths between mdm components

2.11.1 Create the private key and the keystore for each component

It is recommended to create a working directory, e.g. named *security* in your mdm installation directory, where all the keys, certificates and keystores are located.

PostgreSQL

The PostgreSQL database does not need a keystore, the key and the certificate are located in the filesystem.

1. First create a self-signed certificate (DB_{cert}) and an unencrypted private key (DB_{key}) for the database server as described in Chapter 7.1. Please do not encrypt DB_{key} (see Chapter 7.1 for details).
2. The database server is looking for the certificate and the private key in the PostgreSQL data directory (i.e. the subdirectory of the PostgreSQL directory usually named *pgdata*), therefore copy the files *server.crt* (DB_{cert}) and *server.key* (DB_{key}) to this directory.
3. Edit the PostgreSQL configuration file *postgresql.conf* so that it contains the following line:
   ```
   ssl = on
   ```
4. Restart the PostgreSQL server.

mdm server

1. First create an unencrypted private key (IS_{key}) as described in Chapter 7.1:

```
openssl genrsa -des3 -passout pass:yourSSLPW
-out mdm-https-client-key.pem 2048
```

2. Create the self-signed certificate (IS_{cert}) as described in Chapter 7.1:

```
openssl req -batch -new -x509
-key mdm-https-client-key.pem -keyform PEM
-passin pass:yourSSLPW -sha256 -outform PEM
-out mdm-https-client-cert.pem
Create the keystore as described in Chapter 7.1:
```

```
openssl pkcs8 -topk8 -in mdm-https-client-key.pem
-passin pass:yourSSLPW -inform PEM -nocrypt -outform DER |
java -cp . ImportKey -alias mdm -storetype JKS
-keystore mdm-keystore.jks -storepass pass:yourSSLPW
-keypass pass:yourSSLPW -chain mdm-https-client-cert.pem
```

There should be 3 additional files in your directory:

- *mdm-https-client-key.pem*
- *mdm-https-client-cert.pem*
- *mdm-keystore.jks*

Please store the key and the certficate at a secure location. Only the keystore is used by the mdm server, therefore copy it to its final destination. Then the preferences file of the mdm server has to be configured:

- The location of the keystore has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStore***
- The format of the keystore (JKS) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStoreType***
- The password to access the keystore (in the example: *yourSSLPW*) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » keyStorePassword***

To enable the SSL communication to the mdm CA and to the database the following keys of the *preferences.xml* file have to be configured:

- ***server » storage » database » ssl = true***
- ***ca » protocol = https***

mdm CA

1. First create an unencrypted private key (IC_{key}) as described in Chapter 7.1:

```
openssl genrsa -des3 -passout pass:yourSSLPW
-out ca-https-client-key.pem 2048
```

2. Create the self-signed certificate (IC_{cert}) as described in Chapter 7.1:

```
openssl req -batch -new -x509
-key ca-https-client-key.pem -keyform PEM
-passin pass:yourSSLPW -sha256 -outform PEM
-out ca-https-client-cert.pem
```

3. Create the keystore as described in Chapter 7.1:

```
openssl pkcs8 -topk8 -in ca-https-client-key.pem
-passin pass:yourSSLPW -inform PEM -nocrypt -outform DER |
java -cp . ImportKey -alias ca -storetype JKS
-keystore ca-keystore.jks -storepass pass:yourSSLPW
-keypass pass:yourSSLPW -chain ca-https-client-cert.pem
```

There should be 3 additional files in your directory:

- *ca-https-client-key.pem*
- *ca-https-client-cert.pem*
- *ca-keystore.jks*

Please store the key and the certificate at a secure location. Only the keystore is used by the CA server, therefore copy it to its final destination. Then the preferences file of the CA server has to be configured:

- The location of the keystore has to be configured in the *ca-preferences.xml* file of the mdm server in the node ***httpServer » https » keyStore***
- The format of the keystore (JKS) has to be configured in the *ca-preferences.xml* file of the mdm server in the node ***httpServer » https » keyStoreType***
- The password to access the keystore (in the example: `yourSSLPW`) has to be configured in the *ca-preferences.xml* file of the mdm server in the node ***httpServer » https » keyStorePassword***

To enable the SSL communication to the mdm server and to the database the following keys of the *ca-preferences.xml* file have to be configured:

- ***certificateFactory » storage » database » ssl = true***
- ***httpServer » protocol = https***

To enable client authentication the following key has to be set to *true*:

- ***httpServer » https » clientAuth = true***

2.11.2 Create the truststores

Each component except for the database has a truststore containing the certificates of the trusted peers.

mdm server

1. Create the truststore and add DB_{cert} as described in Chapter „Import a certificate” on page 114:

   ```
   java -cp . ImportKey -alias postgres -storetype JKS
   -file serverCert.pem -storepass pass:yourSSLPW
   -keystore mdm-truststore.jks
   ```

2. Add IC_{cert} as described in Chapter „Import a certificate” on page 114 to the truststore:

   ```
   java -cp . ImportKey -alias ca -storetype JKS
   -file ca-https-client-cert.pem
   -storepass pass:yourSSLPW -keystore mdm-truststore.jks
   ```

3. If SCEP is used, the root certificate and any intermediate certificates the CA server uses to authenticate its reply must be imported into the truststore. Please refer to the documentation of your CA server for details on how to obtain these certificate(s). For example, if the CA server uses a root certificate *scep-ca-cert.pem* and an intermediate certificate *scep-intermediate-cert.pem*:

   ```
   java -cp . ImportKey -alias scep -storetype JKS
   -file scep-ca-cert.pem
   -storepass pass:yourSSLPW -keystore mdm-truststore.jks
   ```

   ```
   java -cp . ImportKey -alias scep1 -storetype JKS
   -file scep-intermediate-cert.pem
   -storepass pass:yourSSLPW -keystore mdm-truststore.jks
   ```

4. Copy the truststore to its final location and configure the preferences file *preferences.xml* of the mdm server:

   - The location of the truststore has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStore***

- The format of the truststore (JKS) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStoreType***
- The password to access the truststore (in the example: *yourSSLPW*) has to be configured in the *preferences.xml* file of the mdm server in the node ***service » security » trustStorePassword***

mdm CA

The certificates of the database and the mdm server are stored in different truststores:

1. Create the database truststore and add DB_{cert} as described in Chapter „Import a certificate” on page 114:

   ```
   java -cp . ImportKey -alias postgres -storetype JKS
   -file serverCert.pem -storepass pass:yourSSLPW
   -keystore ca-database-truststore.jks
   ```

2. Copy the truststore to its final location and configure the preferences file *ca-preferences.xml* of the mdm CA:
   - The location of the truststore has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStore***
   - The format of the truststore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStoreType***
   - The password to access the truststore (in the example: *yourSSLPW*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » storage » database » security » trustStorePassword***
3. Create the mdm server truststore and add IS_{cert} as described in Chapter „Import a certificate” on page 114:

   ```
   java -cp . ImportKey -alias mdm -storetype JKS
   -file mdm-https-client-cert.pem -storepass pass:yourSSLPW
   -keystore ca-mdm-truststore.jks
   ```

4. Copy the truststore to its final location and configure the preferences file *ca-preferences.xml* of the mdm CA:
   - The name including the path of the truststore has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStore***
   - The format of the truststore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStoreType***
   - The password to access the truststore (in the example: *yourSSLPW*) has to be configured in the *ca-preferences.xml* file in the node ***httpServer » https » trustStorePassword***

3 mdm client overview

The mdm client is the graphical front-end to access all features of mdm. It allows to create and manage devices, templates, pools, and VPN groups, initiates the upload of configurations to devices or initiates the export of configuration files to the file system.
For information on how to start and stop the client, please refer to Chapter 2.7.

3.1 Login

Before connecting to the server, you have to authenticate yourself in the login-window. Furthermore the server IP/hostname and the server port to be used can be set in the login window.
The following screenshot shows the login dialog:

Figure 8: The mdm client login window

There are three predefined user accounts: *root*, *admin* and *audit*. *root* can access all settings, *admin* can by default modify all configuration settings and read user management settings, whereas *audit* has read-only permission by default, i.e. the *audit* user cannot change any settings, except for his password. The permissions for the users can be changed, if desired (see Chapter 3.11). The default passwords for user *admin* is **admin**, the default password for user *audit* is **audit**, the default password for *root* is **root**.

☞ It is highly recommended to change the default passwords after installation, please refer to Chapter 3.11 (subsection *Changing user settings*) for more information.

Using multiple clients

Multiple mdm clients using an mdm server instance concurrently are fully supported only by the *mdm 1.6 Unlimited Edition*. All other available editions still have the limitation to two concurrent clients. Entities are locked if this is necessary to prevent two users from editing the same variable simultaneously. This includes inheritance hierarchies (where a user could edit a variable that a descent template or device inherits), but not synthesized VPN connections (which are read-only in the receiving device). If another user tries to open the device or the template an error message will be displayed. If a client opens a *Template Properties Dialog*, then the template and all devices referencing this template will be locked and cannot be opened by another user.
The same is true for pools and VPN groups.
In case the connection between a client and a server is interrupted and cannot be terminated gracefully, the device/template/pool/VPN group that was locked by that client will get released after an inactivity timeout (can be configured in the server configuration, see Chapter 2.6, key *maxInactiveInterval*), i.e. it could happen that certain settings cannot be accessed until the inactivity timeout is reached.

3.2 The mdm main window

The following screenshot shows the mdm main window:

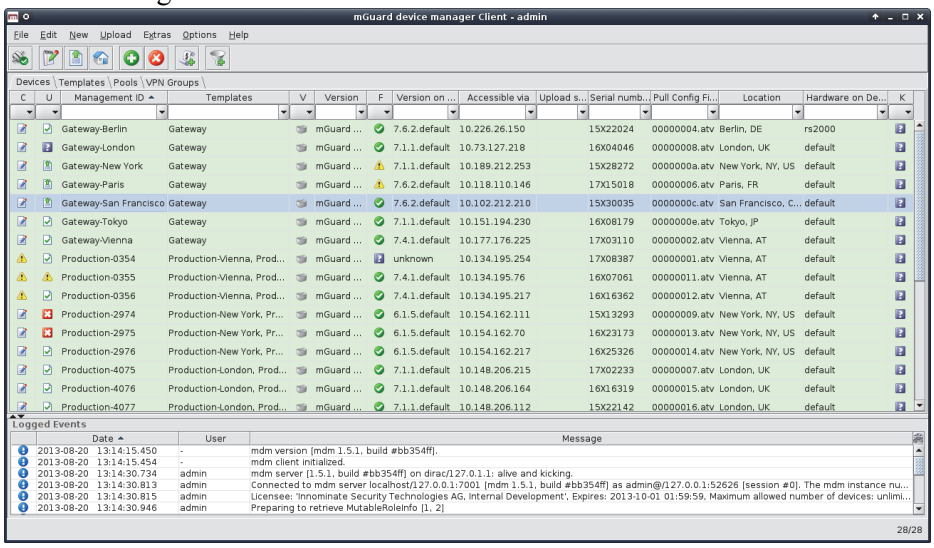

mGuard device manager Client - admin
File Edit New Upload Extras Options Help
Devices \ Templates \ Pools \ VPN Groups \
Logged Events
28/28

Figure 9: The mdm main window

The mdm main window is divided into a tab area for the device/template/pool/VPN group overview tables and a log window. It also contains a tool bar and the main menu. The different sections and their functionality are explained in the following chapters.

3.3 Device overview table

Please select the **Device** tab to access the device overview table.

Device table columns

The device overview table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Status *C*

The column labeled with **C** shows the configuration status of the device, which indicates whether the configuration on the Innominate mGuard differs from the configuration of the device in mdm.
The configuration status can take the following values:

- Unknown
  mdm is not able to determine whether the configuration of your Innominate mGuard is up-to-date.
- OK
  The configuration in mdm is identical to the current configuration of your mGuard.
- Changed
  The configuration in mdm is different to the current configuration of your mGuard, i.e. the changes made with mdm have not yet been uploaded to the device.

- Locked
  The configuration is locked by another user. This can happen if another user opens the *Device Properties Dialog* or the *Template Properties Dialog* of an assigned template.

☞ Please note that configuration changes performed by other means than mdm cannot be detected, i.e. the configuration status is displayed correctly only if solely the *netadmin* user changes the mGuard configuration locally on the device.

☞ If a template is changed the configuration status of **all** mGuards using this template is set to *out-of-date*, no matter whether the template change affected the device configuration or not.

☞ Please refer to Chapter 3.8.1 if you would like to manually reset the configuration status to *up-to-date*.

Status *U*

The column labled with **U** shows the upload status of the device, which indicates the status of a pending upload or the result of the last upload. Please refer to Chapter 3.9 on how to upload configurations to the devices.
The upload status can take the following values:

- Unknown
  mdm could not determine the status yet, since no upload has taken place.
- Up to date
  The configuration on the device has not changed because it already was up to date.
- Updated
  The configuration on the device has been updated.
- Configuration exported
  The configuration files have been successfully exported to the file system.
- Pull feedback received
  The mdm server has received a configuration pull feedback from the HTTPS server, but it could not be determined whether the configuration on the device is now up to date. This status indicates that the device has pulled a configuration file, but has not yet applied it, or that the configuration is outdated, because it has been changed in mdm after the export to the HTTPS server.
- SSH hostkey reset
  Indicates that an SSH host key reset was performed.
- Configuration invalid
  mdm indicates that the current configuration is invalid, e.g. a **None** value (see Chapter 4.2.1) in the template has not been overriden in the device.
- Upload or export error
  A permanent error has occured and mdm could not recover from the error or the maximum number of retries for the SSH configuation push has been reached without accessing the mGuard. The cause of the error is displayed in the log window.

  - Host authentication failed
    This error indicates that the SSH host authentication failed. This can be an indicator of an attack, but most likely it is due to the fact that a failing device was replaced. Before you continue please make sure that the devices in question was indeed replaced. To continue remove the device's active SSH hostkey with the option **Set Current Device Credentials** in the context menu of the device overview table (select the **Reset SSH Host Key** checkbox). The new SSH hostkey will be set with the next SSH connection.
  - User authentication failed
    This error indicates that the user credentials – username *admin* and the password stored in the devices *active password* – were not accepted. It can also indicate that the SSH authentication method *password* was not accepted by the mGuard.
  - I/O failed / Upload failed
    This error indicates that an input/ouput (I/O) failure has occurred. In the case of SSH uploads this is probably a transient error and a retry should be scheduled. In the case of filesystem output (pull config) the failure is probably not transient and the cause should be examined by the user.
  - Concurrent configuration upload
    This indicates that another upload is currently active for the same device. An example is an SSH upload that detects a running pull config script. The usual way to handle this is to reschedule this update.
  - Configuration rejected
    This indicates that the device has rejected the configuration as invalid.
- Upload timeout
  This indicates that the SSH connection to the device has timed out, i.e. the device has no reacted to the commands initiated by the mdm within a given (configurable) time frame. If the configuration contains a large number of VPN connections, it might be necessary to increase the timeout; see Chapter 2.6, node ***service » storage » update » ssh » deadPeerDetectionTimeout***.
- License could not be installed
  This indicates that an mGuard license file could not be installed on the device.
- Pull configuration rolled back
  This indicates that a configuration pulled by the device was rolled back.
- Pull configuration blocked due to previous rollback
  This indicates that configuration is blocked due to a previous rollback.
- Saving configuration for rollback failed
  This indicates that saving the rollback configuration failed, the configuration was not applied.
- Pulled configuration invalid
  This indicates the device detected an invalid pull configuration and therefore the configuration was not applied.

- Firmware upgrade failed
  The scheduled firmware upgrade failed.
- Queued for upload or export
  The device is currently in the upload queue. Depending on the settings for the *configuration push retries* and the *waiting time between retries* the device might stay in the queue for a while.
- Upload or export running
  The device has been accessed and the configuration file is currently being uploaded.
- Requeued for upload or export
  If the device is not accessible, then it will be requeued and after *waiting time between retries* the upload will start again. If after *configuration push retries* the device has not been accessed an error is shown. This icon is also shown during an ongoing firmware upgrade, since mdm will periodically poll the device for the result of the firmware upgrade.

Management ID

The Management ID of the device.

Templates

A comma-separated list of the device's ancestor templates. The first item in the list is the immediate parent template.

Status *V*

VPN group status:

- Not a member of a VPN group
- Member of exactly one VPN group
- Member of more than one VPN group

Hovering over one of the latter two icons with the mouse cursor will display a tooltip listing the VPN group(s) in which the device is a member.

Version

The firmware version currently selected in mdm for this device.

Status *F*

Firmware status:

- Unknown
- OK
  The firmware upgrade was successful and the firmware version configured in mdm corresponds to the firmware version on the device.
- Upgrade scheduled
- Upgrade running
- Version mismatch
  Firmware version configured in mdm and firmware version on device do not match.
- Error
  An error occured during firmware upgrade.

Version on device

The firmware version currently installed on the device. Please refer to Chapter 4.3 for more information.
If the device is in redundancy mode (see Chapter 4.10 for more details), the firmware versions of both devices, separated by a comma, are shown.

Accessible via

The IP address or host name which is used by mdm to access the device. This address can be configured in the **General settings** of the *Device Properties Dialog* (see Chapter 4.3). Without an **Accessible via** address it is not possible to push configurations to the device or open the Web GUI of the device. Please note that this address might not correspond to the internal or external address of the mGuard if NAT is involved.
If the device is in redundancy mode (see Chapter 4.10 for more details), the **Accessible via** addresses of both devices, separated by a comma, are shown.

Upload scheduled at

The date/time the next configuration upload is scheduled for this device.

Serial number

The serial number of this device. Please refer to Chapter 4.3.
If the device is in redundancy mode (see Chapter 4.10 for more details), the serial numbers of both devices, separated by a comma, are shown.

Pull config filename

If the configuration is exported to the file system, a unique ID is used as name of the configuration file. The filename of the configuration file is shown in this column.

Location

In this column the value of the *SNMP Location* variable (*SYS_LOCATION*) is shown. If the location is empty, a "-" character is displayed.
If the device is in redundancy mode (see Chapter 4.10 for more details) and different locations are set for each physical device, the locations of both devices, separated by a comma, are shown.

Hardware

The hardware flavor of the device. See Chapter 3.13 for more details.

Status *K*

The size of the ***ssh*** and ***https*** cryptographic keys on the mGuard:

- Unknown
- 1024 bits
- 2048 bits
- Key renewal scheduled

It is recommended to renew 1024 bit keys. See "Set Current Device Credentials" on page 52 for more details.

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for columns that do not contain text (columns **C**, **U**, **V**, or **F**).
The filter history will be saved for the current user and can be accessed using the drop down functionality of the filter fields.

Creating devices

There are several ways to create new devices:

1. Open the context menu by clicking on the device table with the right mouse button. To open the *Device Properties Dialog* for a new mGuard please select **Add** in the context menu.
2. Select the **Device** tab and click on the icon in the menu bar to open the *Device Properties Dialog* for a new mGuard.
3. Select **New » Device** in the main menu to open the *Device Properties Dialog* for a new mGuard.
4. Select **New » Device Import** in the main menu to import new devices.

Editing devices

There are several ways to edit a device:

1. Double-click with the left mouse button on the device in the table to open the *Device Properties Dialog*.
2. Select the device with the left mouse button and open the context menu by pressing the right mouse button. Then select **Edit** to open the *Device Properties Dialog*.
3. Select the device to be modified in the device table. Select **Edit » Edit Item** in the main menu to open the *Device Properties Dialog*.

   ☞ The **Edit** entry in the context menu and the **Edit** button in the toolbar are only enabled if exactly one device is selected in the device table.

Deleting devices

There are several methods to delete devices:

1. Select the device(s) in the device table and open the context menu by clicking with the right mouse button. To delete the devices please select **Delete** in the context menu.
2. Select the devices to be deleted in the table and click on the icon in the menu bar.

3.3.1 The device context menu

Add

Create a new device and open the *Device Properties Dialog* of the new device.

Edit

Edit the selected device (only active if exactly one device is selected in the overview table).

Duplicate

To create a duplicate of a device please open the context menu by clicking with the right mouse button on the device in the device table. Select **Duplicate** in the context menu. mdm will create a copy of the device and append the string *_copy<n>* (<n> is a number) to the Management ID of the new device. Please note that the **Duplicate** menu entry is only enabled if exactly one device is selected in the device table.

Import ATV Profile

Import ATV profiles into the selected device(s):

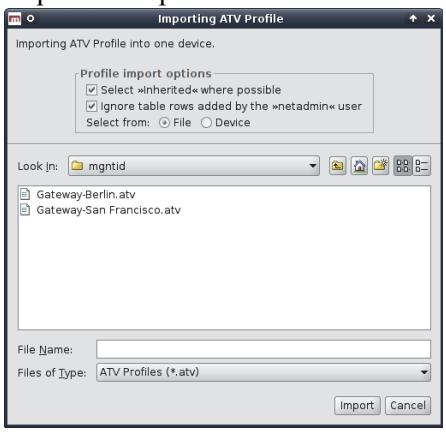


Figure 10: ATV import

The following options are available when importing a profile:

Select Inherited where possible

If this option is selected, variables for which the imported value (i.e. the value in the ATV profile) is the same as the inherited value are set to **Inherited**. Otherwise, all variables contained in the profile are set to **Custom**, regardless of their value.

Ignore table rows added by the *netadmin* user

Tables rows that were created by the local *netadmin* user on the mGuard are not imported.

Select from File/Device

If *File* is selected, the ATV profile to import is uploaded as a file. This option is only available if an ATV import into a single device is performed.

If *Device* is selected, mdm downloads the ATV profile from the mGuard. This requires that mdm can log into the mGuard with the ***ssh*** protocol; the *Accessible via* address must be set.

Import into <A>/<B>

If the device is in redundancy mode (see Chapter 4.10 for more details), the profile can be imported into the configuration variables for the first or the second physical device.

A few configuration variables cannot be imported and must be set manually if necessary: the passwords of the *root* and *admin* users, the passwords of the user firewall users, and certificate revocation lists (CRLs). ATV profiles downloaded from an mGuard either do not contain these variables at all or contain them in encrypted (hashed) form. Please note that mdm does import the password of the *netadmin* user if it is found in the ATV profile, but a profile downloaded from an mGuard does **not** contain it.

Web Configure

Open the Web GUI of the device, if the device is accessible (see also **Accessible via** address in Chapter 4.3)

☞ Any change made with the Web GUI will be overwritten by the next mdm configuration upload (except for changes made as *netadmin* to local variables).

Export

Generate a CSV file containing the basic properties (but not the configurations) of the selected devices. The file is suitable to imported into mdm again (see Chapter 3.8.1, Device Import).

Delete

Delete the selected devices.

Set Firmware Version

Upgrade the firmware version to a new version. Please refer to Chapter 3.12 for more details.

Set Hardware Flavor

Set the hardware flavor. Please refer to Chapter 3.13 for more details.

Assign Template

Open the *Assign template* dialog and assign a template to the selected devices.

Add to VPN Group

Opens a dialog to add the selected devices to a VPN group.

Remove from VPN Group

Opens a dialog to remove the selected devices from a VPN group.

Upload

Open the Upload dialog. Please refer to Chapter 3.9 for more details.

Cancel Upload

Cancel the scheduled upload for the selected devices.

Set Upload State

The upload status will never be set to *successfully uploaded* automatically if no push upload is performed and no pull feedback from the configuration server is received (e.g. in a usage scenario where the exported configuration profiles are installed manually on the devices). You can use this option to set the upload state to *successfully uploaded* manually. Please select the device in the device table, open the context menu with a right click and then select **Set upload state**.

☞ If a device is in a state in which an upload would fail (e.g. if a **None** value has not been overridden, cf. Chapter 4.2.1), it is not possible to set the upload state to *successfully uploaded*.

Export ECS Files

Download encrypted ECS files for the selected devices. ECS files can be used to configure mGuard devices that support this mechanism through SD cards; please refer to the mGuard manual for more details. A dialog is opened where the directory where to store the ECS files can be selected.

☞ The prerequisites for creating encrypted ECS files are same as for encrypted profiles. See “Profile encryption” on page 68.

Show Device Configuration History

Open the configuration history dialog. Please refer to Chapter 6.1 for more detailed information.

Generate Report of Changes to Device Configuration

Open a dialog to generate a report of changes to device configurations. Please refer to Chapter 6.5 for more detailed information.

Upload History

Display an overview over the last upload actions.

Set Current Device Credentials

Open a dialog in which the device credentials can be set. The following attributes can be set:

- Active root and admin passwords

The active passwords are the passwords that are currently in effect on the device. They may differ from the configured passwords when the current configuration has not yet been uploaded to or been pulled from the mGuard. mdm keeps track of the active passwords since the root password is needed to set a new root password, and the admin password is needed to log into the mGuard.

- Reset SSH Host Key
  mdm stores the SSH key of an mGuard after the initial contact. In case an mGuard has been replaced, the SSH keys do not match and mdm will refuse any connection to the replaced device. This function can be used to reset the SSH key.
- Renew Secure Key Length
  If this is selected, the mGuard will generate ***ssh*** and ***https*** keys on the next configuration upload or pull.

  ☞ It is recommended to generate new keys if 1024 bit keys are still in use.

Device Replacement

Resets all settings specific to a device to default values. This can be used if a defective device has been replaced.

The following settings are reset:

- Firmware Version on Device
- Serial Number
- Flash ID
- SSH Hostkey
- Profile Encryption Key
- Licenses associated with the device

Set Redundancy Mode

Open a dialog in which redundancy mode can be enabled or disabled for the selected devices.

Generate Redundancy Passphrases

Set the redundancy passphrase variables in the device configuration to random values.

Generate License

Please refer to Chapter 3.10 for details regarding the license management.

Refresh License

Please refer to Chapter 3.10 for details regarding the license management.

Get Profile Key

Obtain a profile key from the Innominate license server. Please refer to section “Profile encryption” on page 68 for details.

Enable/Disable profile encryption

Enable or disable encryption of configuration profiles for the selected devices. Please refer to section “Profile encryption” on page 68 for details.

Firmware Upgrade » Schedule upgrade to latest patches

Schedule a firmware upgrade to the latest available patches. Please refer to Chapter 3.12 for more details.

Firmware Upgrade » Schedule upgrade to latest minor release

Schedule a firmware upgrade to the latest available minor release. Please refer to Chapter 3.12 for more details.

Firmware Upgrade » Schedule upgrade to next major version

Schedule a firmware upgrade to the next major version. Please refer to Chapter 3.12 for more details.

Firmware Upgrade » Unschedule upgrade

Unschedule a firmware upgrade.

Certificate Handling » Request additional certificate

Request a machine certificate for the device and append it to the list of existing machine certificates. Please refer to Chapter 4.6.1 for more details.

Certificate Handling » Request replacement certificate

Request a machine certificate for the device and replace any existing machine certificates with the new one. Please refer to Chapter 4.6.1 for more details.

☞ All existing machine certificates in the device are deleted, even if they have been imported manually. As a result, the device has a single machine certificate (the newly requested one). This function is therefore most useful for devices which contain a single machine certificate.

Certificate Handling » Issue and Export Certificate Requests

Generate certificate requests for manual certificate enrollment. Please refer to Chapter 4.6.1 for more detailed information.

Select All

Select all devices not excluded by the table filter.

3.4 Template overview table

Please select the **Template** tab to access the template overview table.

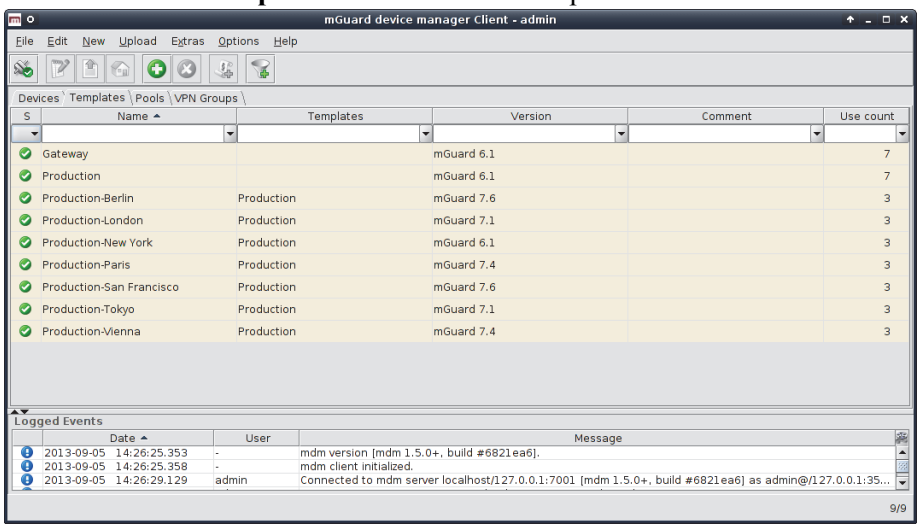

mGuard device manager Client - admin
File Edit New Upload Extras Options Help
Devices Templates Pools VPN Groups
S Name Templates Version Comment Use count
Gateway mGuard 6.1 7
Production mGuard 6.1 7
Production-Berlin Production mGuard 7.6 3
Production-London Production mGuard 7.1 3
Production-New York Production mGuard 6.1 3
Production-Paris Production mGuard 7.4 3
Production-San Francisco Production mGuard 7.6 3
Production-Tokyo Production mGuard 7.1 3
Production-Vienna Production mGuard 7.4 3
Logged Events
Date User Message
2013-09-05 14:26:25.353 - mdm version [mdm 1.5.0+, build #6821ea6].
2013-09-05 14:26:25.358 - mdm client initialized.
2013-09-05 14:26:29.129 admin Connected to mdm server localhost/127.0.0.1:7001 [mdm 1.5.0+, build #6821ea6] as admin@127.0.0.1:35...
9/9

Figure 11: The mdm main window with template table

Template table columns

The template overview table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Status

The status icon shows whether the template is currently locked.

Name

The name assigned to the template. The name can be set in the **General Settings** of the *Template Properties Dialog* (see Chapter 4.2).

Templates

A comma-separated list of the template's ancestor templates. The first item in the list is the immediate parent template.

Version

The mGuard firmware version that is used for the template.

Comment

Optional comment. The comment can be set in the **General Settings** of the *Template Properties Dialog* (see Chapter 4.2).

Use count

This column shows the number of devices or other templates using this template.

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for the column that does not contain text (i.e. column **S**).

The filter criterion for the **Use count** column is not interpreted as a regular expression, but as a comma-separated list of numbers or number ranges (e.g. 0,2-3).

The filter history will be saved for the current user and can be accessed using the drop down functionality of the filter fields.

Creating templates

There are several ways to create new templates:

1. Open the context menu by clicking on the template table with the right mouse button. To open the *Template Properties Dialog* for a new template please select **Add** in the context menu.
2. Select the **Template** tab and click on the icon in the menu bar to open the *Template Properties Dialog* for a new template.
3. Select **New » Template** in the main menu to open the *Template Properties Dialog* for a new template.

Editing templates

There are several ways to edit a template:

1. Double-click with the left mouse button on the template in the table to open the *Template Properties Dialog*.
2. Select the template with the left mouse button and open the context menu by pressing the right mouse button. Then select **Edit** to open the *Template Properties Dialog*.
3. Select the template to be modified in the template table. Select **Edit » Edit Item** in the main menu to open the *Template Properties Dialog*.

   ☞ The **Edit** entry in the context menu and the **Edit** button in the toolbar are only enabled if exactly one template is selected in the template table.

Deleting templates

There are several methods to delete templates:

1. Select the template(s) and open the context menu by clicking with the right mouse button. To delete the templates please select **Delete** in the context menu.
2. Select the templates to be deleted in the template table and click on the icon in the menu bar.

☞ Please note that templates that are still assigned to devices or other templates cannot be deleted.

3.4.1 The template context menu

The following entries are available in the context menu of the template overview table:

Add

Create a new template and open the *Template Properties Dialog* of the new template.

Edit

Edit the selected template (only active if exactly one template is selected in the overview table).

Duplicate

To create a duplicate of a template please open the context menu by clicking with the right mouse button on the template in the template table. Select **Duplicate** in the context menu. mdm will create a copy of the template and append the string *_copy<n>* (<n> is a number) to the name of the new template. Please note that the **Duplicate** menu entry is only enabled if exactly one template is selected in the template table.

Import ATV Profile

Import an ATV profile into the selected template(s). This works analogous to the ATV profile import into devices; please refer to Chapter 3.3.1 for details.

Delete

Delete the selected templates.

Set Firmware Version

Upgrade the firmware version to a new version. Please refer to Chapter 3.12 for more details.

Assign Template

Open the *Assign template* dialog and assign a parent template to the selected templates.

Set Redundancy Mode

Open a dialog in which redundancy mode can be enabled or disabled for the selected templates.

Select All

Select all templates not excluded by the table filter.

3.5 Pool value overview table

Please select the **Pool** tab to access the pool overview table. A pool defines a range of network addresses which can be automatically assigned to variables. For detailed information on pools and their usage please refer to Chapter 4.4.

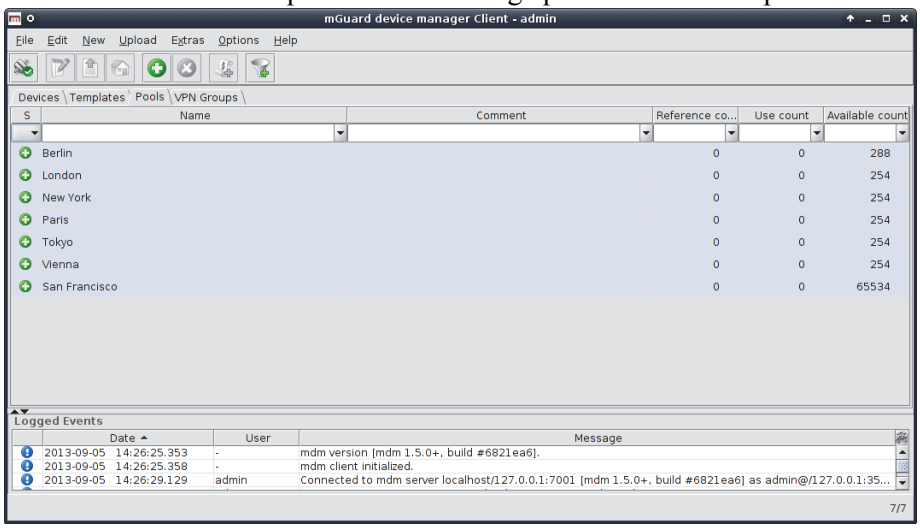

mGuard device manager Client - admin
File Edit New Upload Extras Options Help
Devices Templates Pools VPN Groups
S Name Comment Reference co... Use count Available count
Berlin 0 0 288
London 0 0 254
New York 0 0 254
Paris 0 0 254
Tokyo 0 0 254
Vienna 0 0 254
San Francisco 0 0 65534
Logged Events
Date User Message
2013-09-05 14:26:25.353 - mdm version [mdm 1.5.0+, build #6821ea6].
2013-09-05 14:26:25.358 - mdm client initialized.
2013-09-05 14:26:29.129 admin Connected to mdm server localhost/127.0.0.1:7001 [mdm 1.5.0+, build #6821ea6] as admin@127.0.0.1:35...
7/7

Figure 12: The mdm main window with pool table

Pool table columns

The pool overview table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Status

The status icon shows whether the pool definition is valid.

Name

The name assigned to the pool.

Comment

Optional comment.

Reference count

This column shows how many variables reference this pool (see Chapter 4.4).

Use count

This column shows how many values have been used from the pool (see Chapter 4.4).

Available count

This number shows how many values are still available in the pool (see Chapter 4.4).

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for the column that does not contain text (i.e. column **S**).

The filter criterion for the three **count** columns is not interpreted as a regular expression, but as a comma-separated list of numbers or number ranges (e.g. 0,2-3).
The filter history will be saved for the current user and can be accessed using the drop down functionality of the filter fields.

Creating pools

There are several ways to create new pools:

1. Open the context menu by clicking on the pool table with the right mouse button. To open the *Pool Properties Dialog* for a new pool please select **Add** in the context menu.
2. Select the **Pool** tab and click on the icon in the menu bar to open the *Pool Properties Dialog* for a new pool.
3. Select **New » Pool** in the main menu to open the *Pool Properties Dialog* for a new pool.

Editing pools

There are several ways to edit a pool:

1. Double-click with the left mouse button on the pool in the table to open the *Pool Properties Dialog*.
2. Select the pool with the left mouse button and open the context menu by pressing the right mouse button. Then select **Edit** to open the *Pool Properties Dialog*.
3. Select the pool to be modified in the pool table. Select **Edit » Edit Item** in the main menu to open the *Pool Properties Dialog*.

   ☞ The **Edit** entry in the context menu and the **Edit** button in the toolbar are only enabled if exactly one pool is selected in the pool table.

Deleting pools

There are several methods to delete pools:

1. Select the pool(s) and open the context menu by clicking with the right mouse button. To delete the pools please select **Delete** in the context menu.
2. Select the pools to be deleted in the pool table and click on the icon in the menu bar.

   ☞ Please note that pools that are still referenced by variables cannot be deleted.

3.5.1 The pool context menu

The following entries are available in the context menu of the pool overview table:

Add

Create a new pool and open the *Pool Properties Dialog* of the new pool.

Edit

Edit the selected pool (only active if exactly one pool is selected in the overview table).

Delete

Delete the selected pools.

Select All

Select all pools not excluded by the table filter.

3.6 VPN group overview table

Please select the **VPN Groups** tab to access the VPN group overview table. A VPN group is used to group devices into a meshed VPN network. For detailed information on VPN groups and their usage please refer to Chapter 4.8.

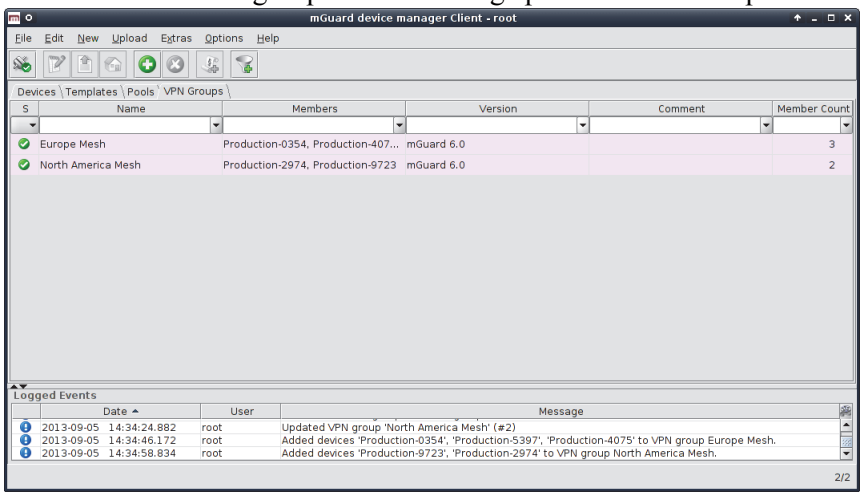

mGuard device manager Client - root
File Edit New Upload Extras Options Help
Devices Templates Pools VPN Groups
S Name Members Version Comment Member Count
Europe Mesh Production-0354, Production-407... mGuard 6.0 3
North America Mesh Production-2974, Production-9723 mGuard 6.0 2
Logged Events
Date User Message
2013-09-05 14:34:24.882 root Updated VPN group 'North America Mesh' (#2)
2013-09-05 14:34:46.172 root Added devices 'Production-0354', 'Production-5397', 'Production-4075' to VPN group Europe Mesh.
2013-09-05 14:34:58.834 root Added devices 'Production-9723', 'Production-2974' to VPN group North America Mesh.
2/2

Figure 13: The mdm main window with VPN group table

VPN group table columns

The VPN group overview table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Status

The status icon shows whether the VPN group is currently locked.

Name

The name assigned to the VPN group. The name can be set in the **General Settings** of the *VPN Group Properties Dialog* (see Chapter 4.8).

Members

A comma-separated list of the devices which are members of the VPN group (i.e. which are a part of the meshed VPN network defined by the VPN group).

Version

The mGuard firmware version that is used for the VPN group.

Comment

Optional comment. The comment can be set in the **General Settings** of the *VPN Group Properties Dialog* (see Chapter 4.8).

Member Count

This column shows the number of devices which are members of the VPN group.

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for the column that does not contain text (i.e. column **S**).

The filter criterion for the **Member Count** column is not interpreted as a regular expression, but as a comma-separated list of numbers or number ranges (e.g. 0,2-3).
The filter history will be saved for the current user and can be accessed using the drop down functionality of the filter fields.

Creating VPN groups

There are several ways to create new VPN groups:

1. Open the context menu by clicking on the VPN group table with the right mouse button. To open the *VPN Group Properties Dialog* for a new VPN group please select **Add** in the context menu.
2. Select the **VPN Group** tab and click on the icon in the menu bar to open the *VPN Group Properties Dialog* for a new VPN group.
3. Select **New » VPN Group** in the main menu to open the *VPN Group Properties Dialog* for a new VPN group.

Editing VPN groups

There are several ways to edit a VPN group:

1. Double-click with the left mouse button on the VPN group in the table to open the *VPN Group Properties Dialog*.
2. Select the VPN group with the left mouse button and open the context menu by pressing the right mouse button. Then select **Edit** to open the *VPN Group Properties Dialog*.
3. Select the device to be modified in the device table. Select **Edit » Edit Item** in the main menu to open the *VPN Group Properties Dialog*.

   ☞ The **Edit** entry in the context menu and the **Edit** button in the toolbar are only enabled if exactly one VPN group is selected in the VPN group table.

Deleting VPN groups

There are several methods to delete VPN groups:

1. Select the VPN group(s) in the VPN group table and open the context menu by clicking with the right mouse button. To delete the VPN groups please select **Delete** in the context menu.
2. Select the VPN groups to be deleted in the table and click on the icon in the menu bar.

   ☞ Please note that VPN groups that still have member devices cannot be deleted.

3.6.1 The VPN group context menu

The following entries are available in the context menu of the VPN group overview table:

Add

Create a new VPN group and open the *VPN Group Properties Dialog* of the new VPN group.

Edit

Edit the selected VPN group (only active if exactly one VPN group is selected in the overview table).

Duplicate

To create a duplicate of a VPN group please open the context menu by clicking with the right mouse button on the VPN group in the VPN group table. Select **Duplicate** in the context menu. mdm will create a copy of the VPN group and append the string *_copy<n>* (<n> is a number) to the name of the new VPN group. Please note that the **Duplicate** menu entry is only enabled if exactly one VPN group is selected in the VPN group table.

Delete

Delete the selected VPN groups.

Set Firmware Version

Upgrade the firmware version to a new version. Please refer to Chapter 3.12 for more details.

Assign/Remove Member Devices

Edit member devices of one or more VPN groups. Please refer to Chapter 3.6.2 for more details.

Select All

Select all VPN groups not excluded by the table filter.

3.6.2 Editing device membership in VPN groups

When *Assign/Remove Member Devices* in the VPN group context menu is activated, a dialog opens to edit the device membership of the selected VPN groups:

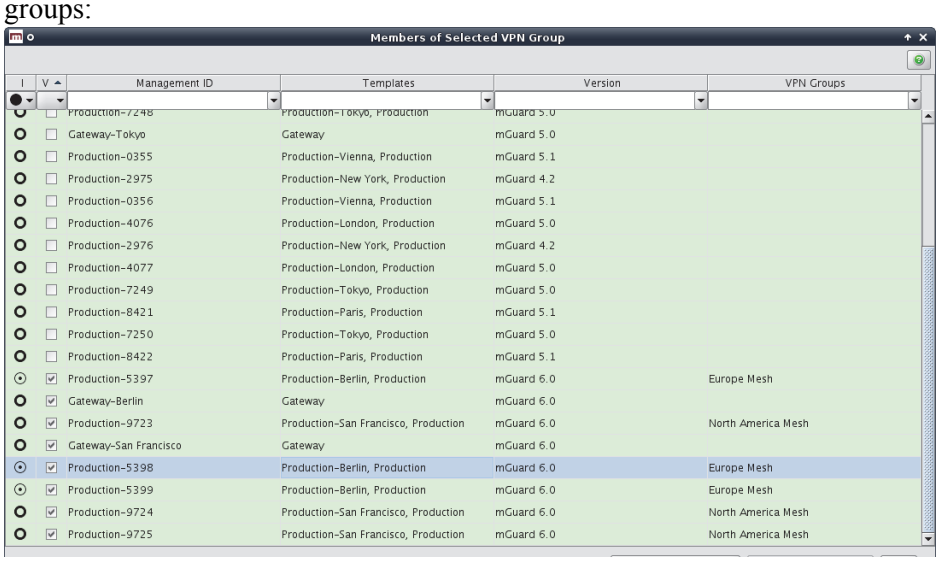


Figure 14: The dialog to edit device membership in VPN groups

VPN group membership table columns

The VPN group membership table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Status *I*

The **I** status icon indicates whether a device is a member of none, some, or all of the selected VPN groups. Click on the icon to open a dialog which explains the available icons and their meanings.

Status *V*

The **V** status icon shows whether the firmware version of the device is compatible with (i.e. equal to or newer than) the firmware version of the selected VPN groups.

Management ID

The Management ID of the device.

Templates

A comma-separated list of the device's ancestor templates. The first item in the list is the immediate parent template.

Version

The firmware version of the VPN group.

VPN Groups

A comma-separated list of VPN groups that the device is currently a member of.

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for the columns that do not contain text (i.e. columns **I** and **V**).

Selecting devices

Select the device(s) for which to modify the VPN group membership:

- Click on a device to select it.
- Click on a device, then hold down the *Shift* key and click on a second device to select a range of devices.
- Click on a device while holding down the *Ctrl* key to toggle its selection state.

Assigning or removing VPN group membership

Click on the *Attach Selected Devices* button to make the selected devices members of the selected VPN groups (i.e. the VPN groups that were selected in the VPN group table when the dialog was opened). Likewise, click on the *Detach Selected Devices* button to revoke the membership of the selected devices from the selected VPN groups.

☞ A device can only be a member of a VPN group if the device's firmware version is equal to or newer than the firmware version of the VPN group.

☞ Any attempt to add a device to a VPN group of which it is already a member, or to remove a device from a VPN group of which it is not a member, is ignored.

☞ Devices are added to or removed from VPN groups in the background. The dialog can be closed while the operation is still being performed.

3.7 Log window

The log window shows various events, including the following:

- Upload results.
- Creation, deletion, modification of a device, template, pool, VPN group, user, or role.
- Connect or disconnect of the client.

For each event, the severity, the date and time, the username, and a message are logged. If an event is not the result of a user action, "–" is logged instead of the username. Double-clicking on a log entry opens a window with detail information.

Sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The context menu The context menu is opened by clicking on the log window with the right mouse button. The following actions can be performed:

Show Persistent Event Log

Opens the *Persistent Event Log Window*. Please refer to Chapter 3.7.1 for more details.

Clear

Deletes the log entries. This applies to the current mdm client only, i.e. other clients are not affected.

Export

Opens a file chooser window and exports the log entries to an XML file.

Filter Log Entries

Enables or disables the filter for the log entry table. If the filter is enabled, the first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries.

Increase Verbosity

Enables or disables verbose logging. If verbose logging is enabled, some events which are not normally useful and may be confusing are logged.

Auto-scrolling If a new event is logged, the log window is automatically scrolled so that the new entry is visible by default. The auto-scrolling mechanism can be disabled and re-enabled by clicking on the icon in the upper right corner of the log window.

3.7.1 The persistent event log

The *Persistent Event Log Window* shows selected events from the last 200 days in the same manner as the log window. Unlike the entries in the log window, the entries in the *Persistent Event Log Window* are stored persistently in the mdm database, i.e. they are retained even if the mdm server is restarted.

Range selection Since there can be a large number of persistent log entries, not all entries are automatically loaded from the mdm server when the dialog is opened. By changing the criteria in the **Range Selection** field and clicking the **Apply** button, the history entries matching the specified critera can be loaded.

☞ By default, the latest (i.e. newest) 100 entries are loaded.

All Entries

Loads all log entries.

☞ If the numer of entries is large (i.e. thousands or more), loading all entries may incur a significant delay.

Time Range

Loads all entries which have been created during a time range. The time range must be specified:

- If a lower bound, but not an upper bound is specified, all entries newer than the lower bound are loaded.
- If an upper bound, but not a lower bound is specified, all entries older than the upper bound are loaded.
- If both a lower and an upper bound are specified, all entries created during the time interval given by the bounds are loaded.

Times are specified as an ISO date (**YYYY-MM-DD** where **YYYY** is the year, **MM** is the month of the year between 01 and 12, and **DD** is the day of the month between 01 and 31) optionally followed by an ISO time (**hh:mm:ss** where **hh** is the hour according to the 24-hour timekeeping system, **mm** is the minute and **ss**

is the second). For example, a quarter past 4 p.m. and 20 seconds on December 22nd, 2010 would be written as **2010-12-22 16:15:20**.

Alternatively, click on the icon to select the date from a calender.

Last Entries
Loads the latest (i.e. newest) entries. The number of entries must be specified.

3.7.2 Logging events via syslog

The same events logged in the persistent event log (cf. Chapter 3.7.1), or a subset selected by the severity, can be sent to a syslog server. Please refer to Chapter 2.6 for more details.

3.8 The mdm main menu and tool bar

3.8.1 The mdm main menu

File

Connect to Server/Disconnect from Server
Connects to or disconnects from the server.

Exit
Exits the client.

Edit

Edit Item
Opens the *Properties Dialog* of the currently selected item (device, template, pool, or VPN group) in the overview table.

Web Configure
Opens the Web GUI for the selected devices in the device table.

☞ Only active if at least one device in the device table is selected.

☞ The **Accessible via** address is required for this option. It can be configured in the **General settings** of the *Device Properties Dialog* (see Chapter 4.3)

Cut
Cuts the marked text in the currently active table filter field to the clipboard.

Copy
Copies the marked text in the currently active table filter field to the clipboard.

Paste
Pastes the clipboard contents to the currently active table filter field .

Select All
Selects all entries in the currently active overview table.

New

Device
Creates a new device and opens the *Device Properties Dialog*.

Template
Creates a new template and opens the *Template Properties Dialog*.

Pool
Creates a new pool and opens the *Pool Properties Dialog*.

VPN Group

Creates a new VPN group and opens the *VPN Group Properties Dialog*.

Device Import

Opens a window that allows to select an import file.

With the device import option, you can import an automatically (e.g. with a script) generated file of devices. This can be used to create a large number of devices in mdm without going through the process of creating them manually.

The import file must be *comma-separated value* (CSV) formatted. Either a comma (,) or a semicolon (;) can be used as a field separator. Each record (line) in the file describes a single device and consists of the following fields:

Field	Description
#0	Management ID
#1	Firmware Version
#2	Template Name
#3	“Reachable via” address
#4	Serial Number
#5	Flash ID
#6...#n	Variable assigments

The *Management ID* and *Firmware Version* (fields #0 and #1) are mandatory, all other fields are optional. If a field is empty or non-existent, the corresponding attribute is not set.

The *Firmware Version* field must be a supported firmware version (without patchlevel) as it would appear in the **Version** column of the device overview table, e.g. *mGuard 6.1***.**

The *Template Name* must either be the name of an existing template, which is assigned to the new device, or empty, in which case no template is assigned.

Scalar variables (i.e. variables that store a single value and are not contained in a table) can be set with an assignment of the form *<VARIABLE_NAME>=<VALUE>*.

Example record:

```
My Device,mGuard 6.1,,192.168.2.3,17X46201,,ROUTERMODE=router,
MY_LOCAL_IP=192.168.2.3
```

(Please note that the record must be contained in a single line.)

If a record is not valid, it is skipped and an error message is logged.

Import X.509 Certificates

Import certificates created during the manual certificate enrollment process. Please refer to Chapter 4.6.1 for more detailed information.

Upload

For an overview of the configuration upload process and the different upload methods please refer to Chapter 3.9.

Selected

Uploads configurations to the devices currently selected in the device table.

Changed
Uploads configurations to the devices with a configuration status of *out-of-date*.

All
Uploads configurations to all devices.

Licenses

Please refer to Chapter 3.10 for information on how to manage licenses and vouchers.

Users

Change Own Password
Opens a dialog that enables the current user to change the password.

Manage Users And Roles
Please refer to Chapter 3.11 for details on how to manage users and roles.

Options

Default Browser
Please specify a command line to be used to start the browser. The command line should start with the full path and the name of the binary. Append the string *{url}*, which will be replaced with the URL of the mGuard, e.g. on Windows enter:
C:\Program Files\Firefox\Firefox.exe {url}

Default Firmware Version
This is the firmware version that will be used when creating a new device or template.

Filter
The filter in the device, template, pool, and VPN group table can be switched on and off using this option.

3.8.2 The mdm tool bar

The tool bar offers short-cuts to some of the functions in the main menu or the context menu:

No connection to server; if clicked: connect to server.

Connection established; if clicked: disconnect from server.

Edit the selected entry (device, template, pool, or VPN group).

Upload the configuration to the selected devices.

Open the Web GUI of the selected devices in the device table.

Add an entry (device, template, pool, or VPN group) and open its *Properties Dialog*.

Delete the currently selected entries.

Open a dialog to generate/request licenses from the Innominate license server for the selected devices.

Filter of the current overview table (device, template, pool, or VPN group) is active. If clicked: deactivate the filter.

Filter of the current overview table (device, template, pool, or VPN group) is inactive. If clicked: activate the filter.

3.9 Uploading configurations to the mGuards

Upload methods mdm offers several methods to upload the configuration files to the mGuards:

SSH push

The mdm server accesses the mGuards using the SSH protocol. Subsequently the configuration file is copied to the device and put into operation. Any failures during the upload process are shown in the log window. To use this method the following requirements have to be met:

- In the **General Settings** of the *Device Properties Dialog* an IP address or a hostname has to be set for the field **Accessible via.**
- The mGuard has to be accessible from the mdm server using the **Accessible via** address, i.e. a firewall must not block the traffic and a NAT device in the communication path has to be configured appropriately to allow the communication between the mdm server and the mGuard.
- In case the mGuard is accessed on the untrusted interface, the SSH remote access from the mdm server has to be enabled on the mGuard.
- The passwords to access the device have to be set correctly. For uploading the device configuration to the mGuard, mdm logs in as user *admin*. In case of a password change there are 2 passwords involved: the old password, which is used to access the device and the new password, which will be set after logging in. Therefore mdm automatically keeps track of the active password to be used to access the device and does *not* use the password configured in the *Device Properties Dialog* for this purpose. If you would like to manually change the active password you can use the option **Set Current Device Password** in the context menu of the device table.

If a device is not accessible mdm will retry the connection after a waiting time. As soon as the maximum count of retries is reached mdm will stop trying to upload the configuration and will show an error in the log.

☞ If a configuration change causes the mGuard to reboot (e.g. when switching from stealth to router mode), mdm is not immediately informed whether the configuration has been successfully applied. It will therefore reaccess the device after a waiting time. Adapt the Accessible via setting after the initial upload if necessary. Alternatively the configuration state can be set manually with the option **Set Upload State** in the context menu of the device overview table.

☞ If you change the password in the *Device Properties Dialog* and a subsequent upload of the device configuration fails, it may happen that the password change was applied on the mGuard but mdm was not able to keep track of the succesful change. In this case you have to manually set the active password in mdm using the option **Set Current Device Password** in the context menu of the device overview table, otherwise mdm will not be able to log in for the next upload.

☞ Due to this potential issue it is recommend to apply (upload) password changes separately from extensive configuration changes.

Manual configuration upload

In case there are only a few devices to be configured and the devices cannot be accessed by mdm, it is possible to export the configuration files to the file system and upload them manually to each device using the Web GUI of the respective device. Each device is identified by a unique identifier which is

automatically assigned by mdm. This identifier (8-digit hex string with lower case characters) is used as file name for the export. The convention for the exported configuration file is: <*identifier*>.*atv*. The filename for each configuration file is shown in the **General settings** of the *Device Properties Dialog* and in the device table.

To export configuration files the following requirements have to be met:

- An export directory has to be configured in the preferences file of the mdm server (see Chapter 2.6). Please note that it is not possible to export the files locally on the client side. The files are always exported on the server side to the export directory configured in the server preferences file.
- The export directory has to be accessible and writeable from the server.
- There has to be enough disk space to export the files.

Configuration pull

The mGuards are able to pull configuration files from an HTTPS server. mGuards running firmware version 5.0 or newer can additionally pull license files.

To use the configuration pull feature please refer to the section *Manual configuration upload* above for a description how to export configuration and license files. Additionally the following requirements have to be met:

- An HTTPS configuration pull server has to be configured (see Chapter 2.10).
- The configuration pull has to be configured on the mGuards (please refer to the *Reference Manual mGuard Firmware*).
  Additionally the mGuards have to be configured with the 2 following commands to pull their configuration according to the mdm file name convention:
  ```
  gaiconfig --set GAI_PULL_HTTPS_DIR <your_directory>
  gaiconfig --set GAI_PULL_HTTPS_FILE <identifier>.atv
  ```
- In case that the mdm server and the configuration server are installed on different machines you have to make sure that the mdm export files are synced to the file system of the configuration server.
- Additional steps are necessary if you would like to get a feedback whether or not the configuration pull was successful. mdm is able to receive Syslog messages on port UDP 7514 in order to detect the configuration status of a device if mdm is configured as Syslog server in the configuration server settings.
  Remark: The pull request contains information about the current configuraton status of the mGuard. This information will be sent as Syslog message from the configuration server to mdm. The port on which mdm listens for Syslog messages can be configured in the preferences file of the mdm server (see Chapter 2.6).

Profile encryption

Configuration profiles exported by the mdm server can optionally be encrypted with a device-specific key. The mdm server downloads the key from the Innominate license server. Only the public (encryption) key is known to Innominate; the corresponding private (decryption) key is stored within the mGuard in a special hardware module and cannot be extracted.

Profile encryption can only be used with mGuard hardware that supports this feature. Firmware version 7.6.0 or newer is required.

☞ Since profiles are encrypted with a device-specific key, only the mGuard for which the profile has been encypted can read it.

Follow these steps to encrypt profiles:

- Obtain a username and password to download profile keys from Innominate support. Configure the mdm server to use the username and password; see Chapter 2.6, nodes ***license » licenseServer » reqUsername*** and ***license » licenseServer » reqPassword***.
- Select the devices for which to encrypt profiles in the device overview table.
- Select the menu entry *Get Profile Key* in the context menu to download the keys to the mdm server. The serial numbers and flash IDs of the devices are used to identify them to the licsense server and must therefore be known to mdm; set them if necessary.
- Select the menu entry *Enable/Disable profile encryption* in the context menu to enable profile encryption.

Performing an upload

You have the following options to initiate an upload of the configuration to the devices:

- Open the menu **Upload** in the main menu (Chapter 3.8.1) and select which devices should be uploaded (**All**, **Selected** or **Changed**, i.e. all devices with a configuration status of *out-of-date*).
- Select the entry **Upload** in the context menu (right-click on the device table). This will schedule all currently selected devices in the device table for upload.
- Click on the icon in the tool bar to initiate an upload for the currently selected devices in the device table.

After initiating the upload please specify which upload method you prefer:

Push upload via SSH

mdm tries to upload all scheduled devices using SSH push.

☞ For SSH upload there has to be an IP address or a hostname specified in the field **Accessible via** in the **General settings** of the *Device Properties Dialog* (see Chapter 4.3). If this is not the case, an error will be displayed in the log window and the upload status will be set to error.

☞ If mdm cannot login to the device due to wrong SSH authentication information, an error will be displayed in the log window and the upload status will be set to error.

☞ If the mGuard is not accessible, mdm will retry to upload the configuration. After the maximum retry count is reached an error message will be displayed in the log window and the upload status will be set to error.

Prepare pull configuration

The configuration of all scheduled devices will be exported to the file system.

☞ The export directory can be configured in the preferences file of the server (see Chapter 2.6).

☞ The filename for each configuration file is shown in the **General settings** of the *Device Properties Dialog* and in the device table.

☞ In case the files cannot be written to the file system (no permission, disk capacity exceeded, export directory not existent, etc.), mdm displays an error in the log and the upload status will be set to error.

Auto

Depending on whether or not **Accessible via** in **General settings** is set, mdm will either perform an SSH upload or an export of the configuration to the file system.

Upload time

The time when upload should be performed. Times are specified as an ISO date (**YYYY-MM-DD** where **YYYY** is the year, **MM** is the month of the year between 01 and 12, and **DD** is the day of the month between 01 and 31) optionally followed by an ISO time (**hh:mm:ss** where **hh** is the hour according to the 24-hour timekeeping system, **mm** is the minute and **ss** is the second). For example, a quarter past 4 p.m. and 20 seconds on December 22nd, 2010 would be written as **2010-12-22 16:15:20**. Alternatively, click on the icon to select the date from a calender.

If the current time (which is the default value) or a time in the past is specified, the upload is performed as soon as possible.

The **Upload within … minutes after** field is used to specify an upper bound on the time frame in which mdm will attempt to perform the upload. If it does not succeed within the specified time, mdm will perform no more upload attempts and consider the upload failed.

Temporary Upload Password

If a password is entered into this field, and a push upload is performed, mdm uses this password when logging into the mGuard via SSH. The password is used for all devices. If the field is left empty (default), mdm uses the known *admin* password of each device.

☞ The feature is useful if the mGuard does not use the configured *admin* password to authenticate the login request, e.g. if the mGuard uses RADIUS authentication.

When a temporary upload password is used, mdm can use a username other than *admin* to log into the mGuard. This username can be configured in the *Device Properties Dialog* or the *Template Properties Dialog*. Please open the **Authentication » Local Users » Temporary Upload User** node in the navigation tree.

Upload history

Shows the upload history. The upload history contains details on the last upload actions and their results for each device. To review the upload history for a device, please select the mGuard in the device overview table and open the context menu with a click with the right mouse button. Select **Upload History** to open a window with the upload history.

3.10 Managing license vouchers and device licenses

mdm enables you to centrally manage your license vouchers and device licenses. The main menu contains two entries: **Licenses » Manage Device Licenses** and **Licenses » Manage License Vouchers** which are explained in detail in the following sections.

Managing License Vouchers

To open the *Voucher Management Window* please select **Licenses » Manage License Vouchers** from the main menu.

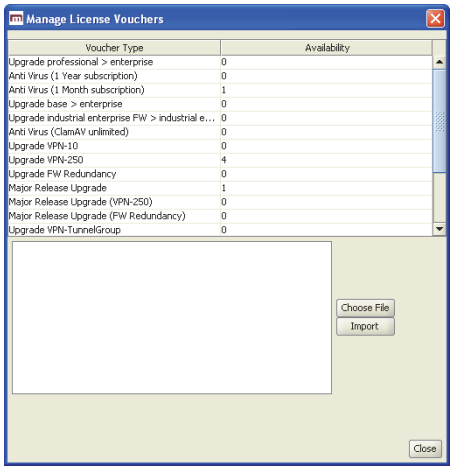


Figure 15: The Voucher Management Window

The window shows the available number of vouchers per voucher type. To import vouchers either paste the voucher information into the import field, or select a file that contains the voucher data and then click on *Import*. Only CSV is supported as import format, i.e. each line of the import data has to contain the following information:

<serial number>,<voucher key>

Requesting/ generating licenses

At least one voucher of the corresponding type (major release upgrade, VPN etc.) has to be imported into mdm before requesting a device license. Furthermore the flash ID and the serial number are required for the license request, i.e. the numbers have to be supplied in the **General Settings** of the device. These identification numbers may be entered manually or are automatically requested from the device during the push or pull upload procedure.

To request licenses, select the devices in the device overview table and either press the icon in the tool bar or select **Generate License** from the context menu. The generated licenses are subsequently shown in the *License Management Window* and on the **Management » Licensing** page in the *Device Properties Dialog* and will be installed on the device with the next upload. The result of the license request is also shown in the log window.

☞ mdm has to be able to connect to the Innominate license server in order to generate/request licenses.

Managing Device Licenses

To open the *License Management Window* please select **Licenses » Manage Device Licenses** from the main menu. All licenses managed by mdm and their licenses details are shown in the *License Management Window*. In addition to license requested/generated by the procedure described in the previous section,

existing licenses can be imported. To import licenses either type or paste the filenames of the license files (one filename per line) into the import field and click on *Import* subsequently, or click on the *Choose File* button and select one or more files in the dialog.

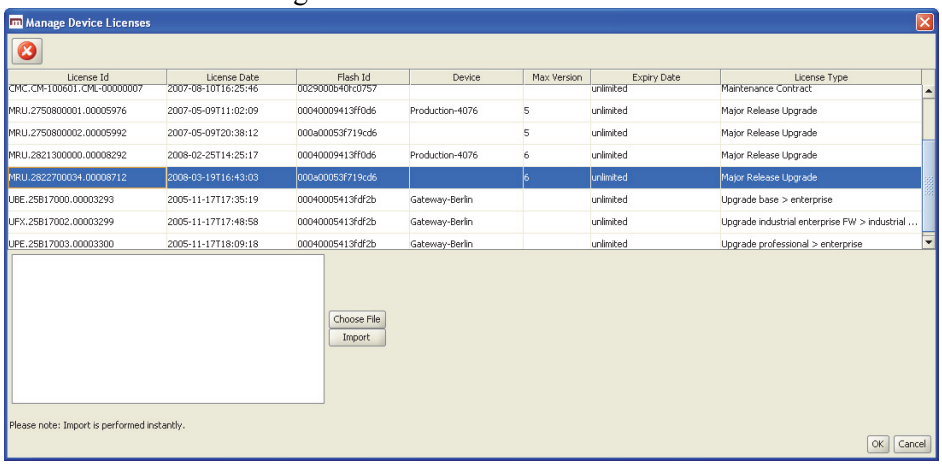

Manage Device Licenses
License Id
License Date
Flash Id
Device
Max Version
Expiry Date
License Type
CMC.CM-100601.CML-00000007 2007-08-10T16:25:46 0029000b40fc0757 unlimited Maintenance Contract
MRU.2750800001.00005976 2007-05-09T11:02:09 00040009413ff0d6 Production-4076 5 unlimited Major Release Upgrade
MRU.2750800002.00005992 2007-05-09T20:38:12 000a00053f719cd6 5 unlimited Major Release Upgrade
MRU.2821300000.00008292 2008-02-25T14:25:17 00040009413ff0d6 Production-4076 6 unlimited Major Release Upgrade
MRU.2822700034.00008712 2008-03-19T16:43:03 000a00053f719cd6 6 unlimited Major Release Upgrade
UBE.25B17000.00003293 2005-11-17T17:35:19 00040005413fdf2b Gateway-Berlin unlimited Upgrade base > enterprise
UFX.25B17002.00003299 2005-11-17T17:48:58 00040005413fdf2b Gateway-Berlin unlimited Upgrade industrial enterprise FW > industrial ...
UPE.25B17003.00003300 2005-11-17T18:09:18 00040005413fdf2b Gateway-Berlin unlimited Upgrade professional > enterprise
Choose File
Import
Please note: Import is performed instantly.
OK
Cancel

Figure 16: The License Management Window

- ☞ A double-click on a license (row) in the table opens the *Device Properties Dialog* of the corresponding device (if any).
- ☞ All licenses managed by mdm will be installed on the devices with every upload.
- ☞ The licenses are automatically assigned to the devices by using the flash ID contained in the license, i.e. without a flash ID in the *General settings* of the device an assignment of the licenses is not possible.

Refreshing licenses

To refresh all licenses in mdm for a device you can select the option **Refresh Licenses** in the context menu of the device overview table. mdm will contact the Innominate license server and retrieve all licenses that were bought for this device. The licenses will be installed with the next configuration upload. You can use this option, if you accidentally deleted licenses in mdm or if you would like to manage an mGuard that has already licenses installed that are not yet managed by mdm.

3.11 Managing users, roles, and permissions

The permission to log into the mdm client, and the permission to perform certain operations once logged in, are controlled through users and roles. A user corresponds to a person logging into the mdm client. Each user has one or more associated roles, and each role has an associated set of permissions. The union of all permissions associated with a user's roles determine what permissions are granted to a user.

- ☞ The permissions are granted when a user logs in, and remain valid until the user logs out. Therefore, any modifications to the user, role, or permission configuration have no immediate effect on logged in users.

User and role management

Users, roles and permissions are managed in the *Users and Roles Dialog*, which is opened through the **Users » Manage Users and Roles** menu entry:

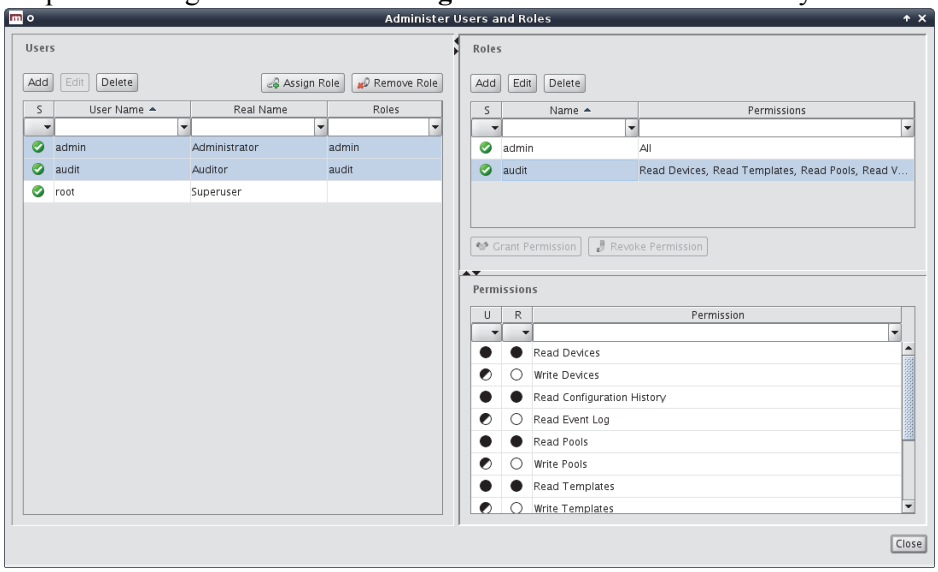


Figure 17: The users and roles dialog

The dialog consists of three panels, the *Users Panel*, the *Roles Panel*, and the *Permissions Panel*.

☞ The *Users Panel* does not appear if RADIUS authentication is used; please refer to Chapter 3.11.4 for more details. The buttons to modify users or roles do not appear if the user opening the *Users and Roles Dialog* does not have the permission to modify users and roles.

3.11.1 Managing users

Users are managed in the *Users Panel* of the *Users and Roles Dialog*. They can be added with the **Add** button, deleted with the **Delete** button, and edited with the **Edit** button or by double-clicking on the user in the table. The following data must be specified when adding or editing a user:

- The username, which the user uses to log into the mdm client. Usernames must be unique.
- The real name. It has no technical effect; its purpose is to make it easier to associate a user with a real person.
- The password. The user must provide the correct password to log into the mdm client.

Assigning roles to users

If one or more users in the *Users Panel* and one or more roles in the *Roles Panel* are selected, the roles can be assigned to the users by clicking the **Assign Role** button or removed by clicking the **Remove Role** button. All of the selected roles are assigned to or removed from all of the selected users.

The superuser *root*

A “superuser” with the username *root* always exists. Although it has no associated roles, it has all permissions (i.e. it is treated specially by mdm). The superuser cannot be deleted, nor can permissions be revoked from the superuser.

Initial users

Three users exist in a fresh mdm installation, *root*, *admin*, and *audit*. The initial password of each of these users is identical to the respective username.

Resetting the root password

If the password for the superuser *root* is lost, it is possible to reset it to *root* with the following psql command (to be performed while the mdm server is not running):

```
UPDATE mgnt_system_users SET "password" =
'WNd6PePC4QrGiz2zeKv6bQ==' WHERE "username" = 'root';
```

3.11.2 Managing roles

Roles are managed in the *Roles Panel* of the *Users and Roles Dialog*. They can be added with the **Add** button, deleted with the **Delete** button, and edited with the **Edit** button or by double-clicking on the role in the table. Each role has a name which must be unique.

Assigning permissions to roles

If one or more roles in the *Roles Panel* and one or more permissions in the *Permissions Panel* are selected, the permissions can be assigned to the roles by clicking the **Grant Permission** button or removed by clicking the **Revoke Permission** button. All of the selected permissions are assigned to or removed from all of the selected roles.

Initial roles

Two roles exist in a fresh mdm installation, *admin*, and *audit*. The *admin* role has all permissions except modification of users and roles. The *audit* role has read permissions, but no modification permissions.

3.11.3 Permissions

The permissions table in the *Permissions Panel* of the *Users and Roles Dialog* lists all available permissions. The permissions grant the following actions:

Permission	Granted Actions
Read Devices	View the list of devices, device configurations, device licenses, and license vouchers.
Write Devices	Edit, add, remove, or duplicate device configurations; add or remove device licenses; add license vouchers. If the user has the *Read Configuration History* permission in addition to this permission: Reconstruct devices from device configuration history entries.
Upload Device Configuration	Initiate the upload of configurations to devices or the export of pull configuration files.
Read Configuration History	View and compare device configuration history entries. If the user has the *Write Devices* permission in addition to this permission: Reconstruct devices from device configuration history entries.
Read Templates	View the list of templates and template configurations.
Write Templates	Edit, add, remove, or duplicate template configurations.
Read Pools	View the list of pools and pool configurations.
Write Pools	Edit, add, or remove pool configurations.
Read VPN Groups	View the list of VPN groups and VPN group configurations.
Write VPN Groups	Edit, add, remove, or duplicate VPN group configurations.

Permission	Granted Actions
Read Users and Roles	View users, roles, and permissions.
Write Users and Roles	Manage users, roles, and permissions (including the permission to set other user's passwords).
Read Event Log	View the persistent event log.

Minimal permission set

The permissions *Read Devices*, *Read Templates*, *Read Pools*, and *Read VPN Groups* form the minimal permission set. These permissions cannot be revoked from a role.

Filtering the permission table

The columns **U** and **R** show how each permission relates to the currently selected users and roles. They can be used to filter the permission table.
The following icons can appear in the **U** column:

○ The permission is not granted to any of the selected users.

◐ The permission is granted to some (but not all) of the selected users.

● The permission is granted to all of the selected users.

Likewise, the same icons are used in the **R** column to express if the permission is assigned to none, some, or all of the selected roles.

3.11.4 User authentication

mdm supports two mechanisms to authenticate users logging into the mdm client, the mdm database and RADIUS.

mdm database authentication

Authentication against the mdm database is the default mechanism. It uses the usernames and passwords stored in the mdm database and configured in the *Users Panel* of the *Users and Roles Dialog* to authenticate users. Please refer to Chapter 3.11.1 for more details.

RADIUS authentication

Remote Authentication Dial In User Service (RADIUS) is a network protocol that provides a remote authentication service. If the mdm server is configured to use RADIUS authentication, the users stored in the mdm database are ignored. When a user attempts to log into the mdm client, the mdm server performs a request to one or more RADIUS servers to authenticate the user. The RADIUS reply must contain one or more *Filter-Id* attributes which the mdm server interprets as role names. If the login attempt is sucessful, the user is assigned to the roles specified in the *Filter-Id* attributes.

☞ If RADIUS authentication is used, mdm does not use the concept of a superuser. The username *root* is not treated specially in any way.

Please refer to Chapter 2.6 for more information on how to configure the mdm server to use RADIUS authentication.

3.12 Managing firmware upgrades with mdm

mdm supports the management of the firmware of your mGuards. The firmware itself is not uploaded to the device by mdm. mdm instructs the device during the configuration upload to download a firmware upgrade package from an upgrade server and apply it.

Prerequisites

- An upgrade server has to be set up and the required update packages etc. have to be put on the server. The upgrade server has to be accessible from the devices (and not necessarily from mdm).
- The server has to be configured in the device configuration (or in the

template configuration). For 4.2 devices please navigate in the *Properties Dialog* to **Management » Firmware upgrade » Upgrade servers** or for 5.0 devices or newer navigate to **Management » Update » Firmware upgrade » Upgrade servers** to add your upgrade server to the configuration.

- If you use the automatic firmware upgrade (see section below) together with a pull upload, make sure that the field **Firmware Version on Device** (see Chapter 4.3) has a valid value. The value can either be entered manually or alternatively mdm will automatically fill in this information after the initial push upload or pull configuration feedback. If entered manually the **Firmware Version on Device** field must *exactly* match the string shown in the icon in the upper-left corner of the mGuard's web interface, e.g. *6.1.0.default*.

Scheduling a firmware upgrade

There are two ways to schedule a firmware upgrade:

- Explicitly specify the target firmware
  To do so please navigate in the *Device Properties Dialog* to **Management » Firmware upgrade » Schedule firmware upgrade** for 4.2 devices or navigate to **Management » Update » Firmware upgrade » Schedule firmware upgrade** for 5.0 or newer devices. Enter the name of the package in the field **Package set name** and set **Install package set** to **Yes**.
- Perform an automated upgrade
  If you wish to use the automatic upgrade please navigate in the *Device Properties Dialog* to **Management » Firmware upgrade » Schedule firmware upgrade** for 4.2 devices or navigate to **Management » Update » Firmware upgrade » Schedule firmware upgrade** for 5.0 devices. Select one of the following options in **Automatic upgrade**:
  - Install latest patches
    This option will upgrade your device to the latest available patch release, e.g. from release 4.2.1 to release 4.2.3.
  - Install latest minor release
    This option will upgrade your device to the latest available minor release, e.g. from release 5.0.1 to release 5.1.0.
  - Install next major version
    This option will upgrade to the next major release, e.g. from release 4.2.3 to release 5.1.0.
    Please make sure that the major upgrade licenses for the devices are present in mdm (see Chapter 3.10) prior to initiating a major release upgrade.

  Alternatively you can schedule the automatic firmware upgrade for one or more devices using the context menu of the device overview table. Please open the context menu by right-clicking on the device table, then select the desired upgrade option.

  ☞ To finally initiate the firmware upgrade the configuration has to be uploaded to the devices, after performing the steps above.

Canceling the scheduled firmware upgrade

You can unschedule a scheduled firmware upgrade with the option **Unschedule upgrade** in the context menu of the device overview table.

Upgrade process

When performing an upgrade it is important to follow the correct order of the steps. Let us assume you would like to upgrade a device from release 4.2.3 to 5.1.0. The current firmware version configured (in the field **Firmware Version** in the *Device Properties Dialog*) in mdm is 4.2 corresponding to the firmware version on the device, which is also a 4.2 version. This should be indicated in the **Version on Device** field in the device overview table (see Chapter 3.3). Make sure that all required prerequisites (see section *Prerequisites* above) are fulfilled

and start a configuration upload for the device (see section *Scheduling a firmware upgrade* above). First the icon in the **Version on Device** column will change to , indicating that a firmware upgrade has been scheduled with the next upload. As soon as the configuration upload is started, the icon changes to , indicating that a firmware upgrade is ongoing on the device (the icon is only shown when performing a push upload). mdm polls the device periodically to get a feedback on the result of the firmware upgrade, which will finally be shown in the **Version on Device** field in the device overview table and in the ***U*** column of the device overview table. The **Version on Device** field should now indicate a firmware mismatch, since the device has been upgraded to 5.1.0, but the mdm configuration for the device is still set to version 4.2. Therefore you should change the firmware version for the device to match the currently installed firmware. This has to be performed *after* the firmware upgrade on the device took place. You can change the firmware version in the field **Firmware Version on Device** in the *Device Properties Dialog* or using the context menu of the device overview table. You can now start to configure features introduced with the new firmware version.

Monitoring the firmware upgrade

The firmware upgrade progress and the result is indicated by the icon in the column **Version on device** in the device overview table. Please refer to Chapter 3.3 for more information.

3.13 Hardware flavors

Most mGuard devices support the same configuration variables, irrespective of their hardware. However, the mGuard *rs2000 / rs2000 3G* supports only a limited set of variables. *rs2000* devices can be managed with mdm through its hardware flavor mechanism.

A device can be set to one of two hardware flavors, *default* or *rs2000*. Setting it to *rs2000* has the effect that variables not supported by this platform are omitted.

Templates have no hardware flavor; they always contain all the variables corresponding to the *default* flavor. If variables not supported by a device set to the *rs2000* flavor are inherited from a template, such variables are ignored.

Some variables are supported on *rs2000* devices, but have only a limited range of supported values. If such a variable is inherited by a device set to the *rs2000* flavor, and the inherited value is not supported, the variable becomes invalid and must be corrected in the configuration dialog before the device can be uploaded.

The mdm 1.6 does not support *mGuard rs2000 3G* devices as a separate hardware flavor. The hardware flavor r*s2000* with network mode *Router* should be used instead.

4 Template, device, pool, and VPN group configuration

4.1 General remarks

The *Device Properties Dialog*, the *Template Properties Dialog*, the *Pool Value Properties Dialog*, and the *VPN Group Properties Dialog* are used to configure devices, templates, pools, or VPN groups, respectively. The device and template dialogs are very similar, therefore the common parts are described in this chapter. Chapter 4.2 and Chapter 4.3 discuss the differences between the two dialogs. The pool configuration is explained in Chapter 4.4. For detailed information on the template and inheritance concept please refer to Chapter 5. The VPN group configuration is described in Chapter 4.8.

Navigation tree

On the left side of the dialog you can find the navigation tree, which resembles the menu structure of the mGuard Web GUI. Compared to the mGuard GUI the navigation tree contains an additional entry **General Settings**, which contains template and device parameters only used in mdm. For more information on the **General Settings** please refer to the following chapters. The navigation tree also has a context menu, which can be opened by clicking on the tree with the right mouse button. The context menu contains various entries to fold/unfold parts of the tree. Furthermore the context menu shows the key shortcuts to access the menu entries.

mGuard configuration

The navigation tree allows to navigate conveniently to the mGuard variables. If you click on a “leaf” of the tree, the corresponding mGuard variables and the associated settings are shown in the right area of the *Properties Dialog*. Depending on the variable, different value types can be selected (exemplarily shown for the *Device Properties Dialog)*:

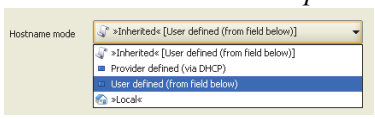

Hostname mode
»Inherited« [User defined (from field below)]
»Inherited« [User defined (from field below)]
Provider defined (via DHCP)
User defined (from field below)
»Local«

Figure 18: Value types of an mGuard variable with a fixed value set

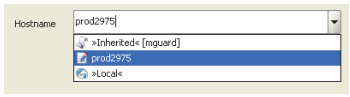


Figure 19: Value types of an mGuard variable with an editable value

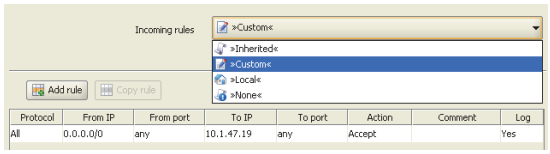


Figure 20: Value types of an mGuard table variable

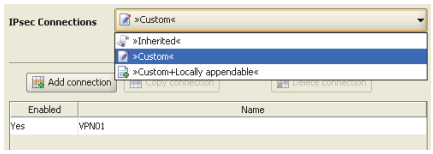


Figure 21: Value types of an complex mGuard table variable

Variables with a fixed value set

Variables with a fixed value set allow the following choices:

- **Inherited**
  Set the variable to the default value or to the value defined in an assigned template (if applicable). The usage of templates and inherited values is further explained in Chapter 4.2 and Chapter 5.
- **Local**
  The mGuard supports (among others) two roles, the *admin* who is able to change all mGuard variables and the *netadmin* who is able to change only local variables. The **Local** value determines whether a variable is local, i.e. whether or not it can be managed by the *netadmin* on the mGuard. If a variable is local, it will ***not be managed by mdm anymore*** in order to avoid conflicts between mdm and the *netadmin*.
- Fixed values
  A number of fixed values which can be selected for this variable. The selectable values depend on the variable. In the example above (Figure 18) the fixed values are: **Provider defined** and **User defined** for the variable **Hostname mode**.

Variables with an editable value

Variables with an editable value allow the following choices:

- **Inherited**
  See above.
- **Local**
  See above.
- **Custom**
  If you select the **Custom** value entry, the combo box becomes editable and you can enter a specific value for the variable, e.g. **prod2975** in the example in Figure 19. The value you entered is subsequentely shown as available selection in the combo box.

Table variables (e.g. incoming firewall rules)

Table variables allow the following choices (for more information on tables please see below in the Chapter *Modifying mGuard table variables*):

- **Inherited**
  Set the variable to the default rows or to the rows defined in an assigned template (if applicable). The inherited rows are shown at the beginning of the table in a different color and are not editable or selectable. The usage of templates and inherited values is further explained in Chapter 4.2 and Chapter 5.
- **Local**
  See above.
  If you set a table variable to **Local** and mdm shows an error, please check whether *May append* is set as permission in the template (if any). If *May append* is selected as permission for the table in the template, it is only allowed to append rows in the *Device Properties Dialog*, therefore the selection of **Local** results in an error.
- **Custom**
  If you select **Custom** the table and its associated menu elements become enabled. Table rows defined in a template are copied from the template to the device and can be deleted or edited in the *Device Properties Dialog* (please note that deleting or editing the rows does not change the rows in the template). You may also add new rows to the table.

☞ Please note that it is possible to switch between **Custom** and the other value types without losing any data. But if you switch from **Custom** to e.g. **Inherited** and then apply your settings and leave the dialog, all custom rows you entered will be lost.

- **Custom + Locally appendable** (*Device Properties Dialog* only)
  Basically the same as **Custom**, but this option allows the user *netadmin* on the mGuard to add further rows. (The rows defined in mdm cannot be edited or deleted by the user *netadmin* on the mGuard.)

Complex table variables (e.g. VPN connections)

Contrary to "normal" table variables, adding a row to or deleting a row from a complex table variable additionally adds or deletes a node from the navigation tree. An example for a complex table variable are the VPN connections: a VPN connection is represented by a table row in the overview table and by an additional node in the navigation tree, in which the settings for the connection can be made. Please note that the table cells of complex tables are not editable, i.e. all settings have to be made in the leafs of the navigation tree node.

Complex table variables allow the following choices (for more information on tables please see below in the Chapter *Modifying mGuard table variables*):

- **Inherited**
  The behaviour is basically the same as described for the "normal" table variables above. Inherited rows from a template which also appear as navigation tree nodes are all set to read-only if **Inherited** is selected for the complex table variable. The usage of templates and inherited values is further explained in Chapter 4.2 and Chapter 5.
- **Custom**
  If you select **Custom** the table and its associated menu elements become enabled. Contrary to "normal" table variables the inherited table rows are *not* copied from the template to the device when switching to **Custom**. Inherited rows cannot be deleted, but can be edited if **Custom** is selected. Please note that changing or editing the rows does not change the rows in the template. You may also add new rows (nodes) to the table.

  ☞ Please note that it is possible to switch between **Custom** and **Inherited** without losing any data while the *Properties Dialog* is open. But if you switch from **Custom** to **Inherited**, apply your settings, and then leave the dialog, all custom rows you entered will be lost.

Additional configuration in the template

In the *Template Properties Dialog* you can find additional settings for the variables. These settings are explained in Chapter 4.2.

Indication of invalid input

Invalid input will be immediately indicated by a red variable name and by error icons in the navigation tree, as shown in the following figure for the external IP address:

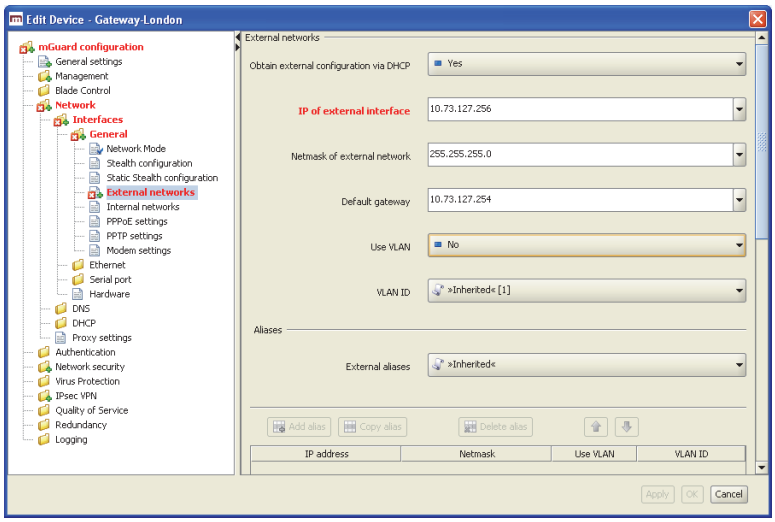


Figure 22: Input verification / invalid input

Indication of changed values

The icon in the leafs of the navigation tree (see the following figure) indicates that a change has been made to a variable in the leaf but has not been applied yet.

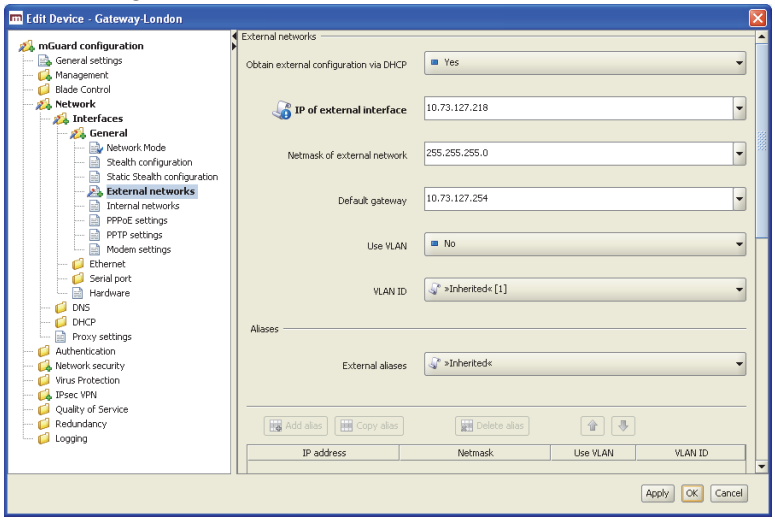


Figure 23: Indication of non-applied changes

The icon in the leafs of the navigation tree (see the following figure) indicates that settings have been changed in the respective leaf and have been applied.

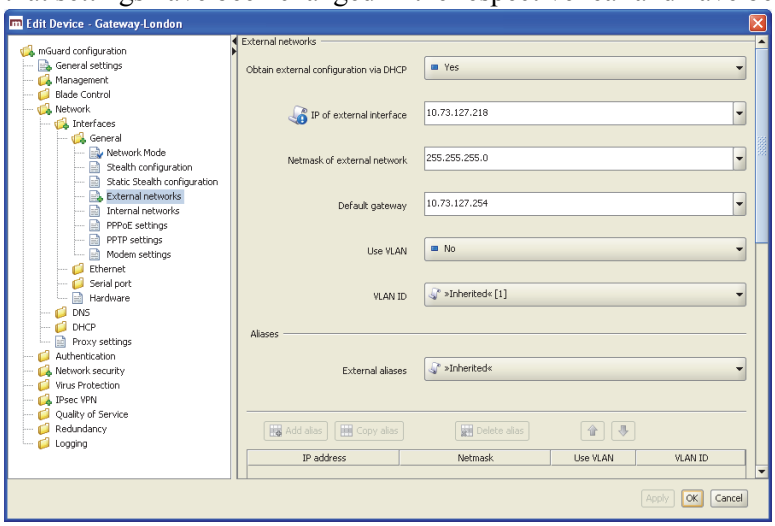


Figure 24: Indication of applied changes

Indication of *None* value

The icon in the leafs of the navigation tree (see the following figure) indicates that a **None** value which has not been overridden (set) in the template hierarchy yet is selected in one of the ancestor templates.

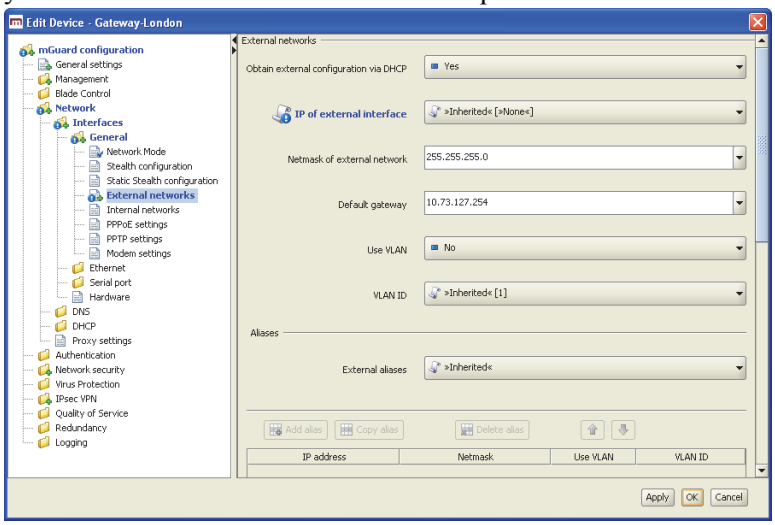


*Figure 25: Indication of **None** value*

Modifying mGuard table variables

The following figure shows an example of a table variable (incoming firewall rules):

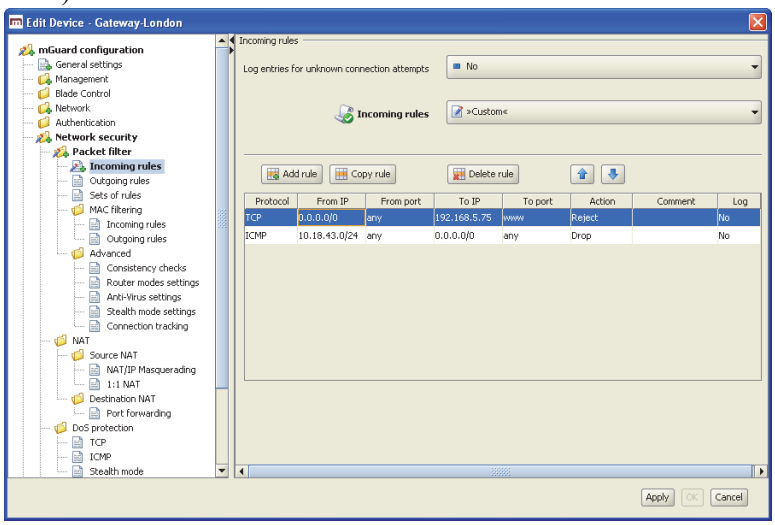


Figure 26: Modifying table variables

Add, delete, copy, or move rows

To add, delete, copy, or move rows, please use the respective buttons.

If none of the rows is selected then a click on the **Add** button will add the row at the beginning of the table. If one or more rows are selected, a new row will be added after the last selected row.

The **Delete** button is enabled only if at least one row is selected. It deletes the selected rows.

The **Copy** button is enabled only if at least one row is selected. It copies the selected rows and inserts them after the last selected row.

The **Move** buttons are enabled only if at least one row is selected. To move the current selection up one row press the button; to move it down please press the button.

☞ The **Add**, **Delete**, **Copy,** and **Move** buttons are enabled only if either **Custom** or **Custom + locally appendable** is selected. Please refer to the Section *mGuard configuration* above.

Selecting table rows

By clicking on a table row with the left mouse button you select it. Multiple rows can be selected as a contiguous block of rows either by first selecting the upper or lower row of the block and then selecting the opposite row with a left click while holding the <*Shift*> key.

Rows can be added to the selection or removed from the selection by clicking with the left mouse button on the row while pressing the <*Ctrl*> key.

Changing a table cell

To edit a table cell please double click on the cell with the left mouse button. (A single click selects the table row).

Invalid values in tables

An invalid value in a table will not be indicated in the navigation tree, but the cell will be marked red. If you enter an invalid value in a table cell, and leave the cell e.g. by clicking on another navigation tree node, the last applied (valid) value will replace the invalid input.

Row colors

The rows of a table may have different colors, depending on the type of row. Inherited rows from an ancestor template are colored red, green or grey:

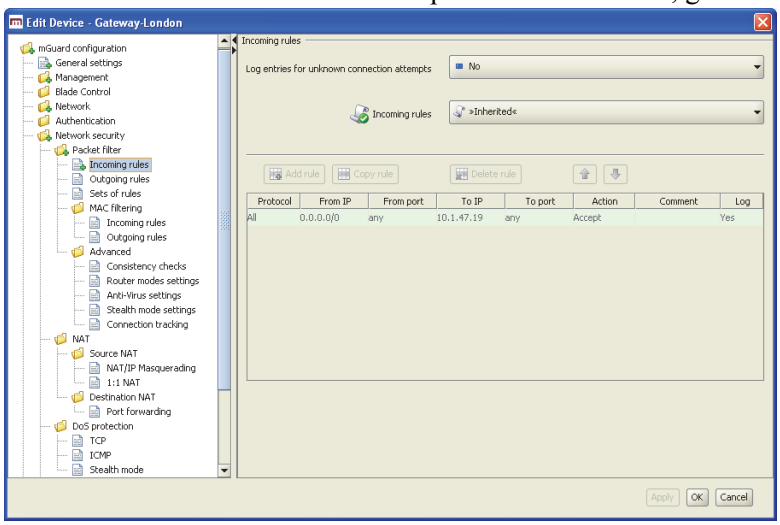


Figure 27: Table row colors

A green row indicates that the row is editable, a red row indicates that the row cannot be edited or deleted and a grey row indicates that this is an inherited default row (which can be changed).

☞ To change a green or grey row it is necessary to switch the value of the table from **Inherited** to **Custom**.

Context menu

Tables can also be edited using the context menu. Please click on the table with the right mouse button. The following menu will appear:

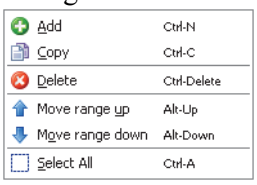


Figure 28: Context menu

Modifying complex table variables

For the definition of a complex table variable please refer to the section *mGuard configuration* above. Basically the previous section also applies to complex table variables. However there are some differences that the user should be aware of.
The following figure shows an example of a complex table variable (VPN connections):

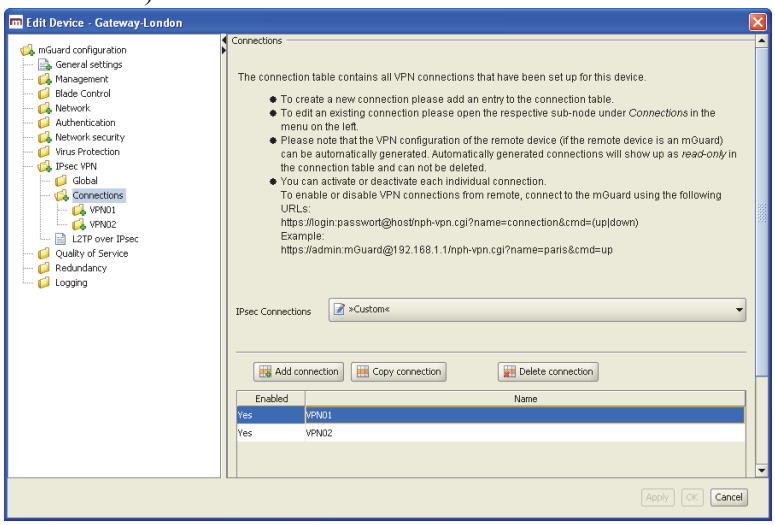


Figure 29: Modifying complex table variables

A complex table does not allow to move rows (the respective buttons are missing). Furthermore the cells of complex tables cannot be edited. Adding a row to a complex table also results in adding a node to the navigation tree (see Figure 29).

☞ The **Add, Copy,** and **Delete** buttons are enabled only if **Custom** or **Custom+Locally appendable** is selected. Please refer to the Section *mGuard configuration* above.

Applying changes to the configuration

Changes made to the configuration are permanently stored with the **Apply** button (at the bottom of the dialog). If you make any changes without applying them, you can discard your changes by closing the dialog with the **Cancel** button. You can also apply your changes by closing the dialog with the **OK** button.

☞ Please note that the configuration is **not** automatically transferred to the mGuard after applying a change. To transfer the configuration to an mGuard, you have to upload the configuration file (please refer to Chapter 3.9) to the mGuard.

4.2 The *Template Properties Dialog*

Templates offer a powerful mechanism to conveniently configure and manage a large number of devices.
By assigning a template to a device (cf. Chapter 4.3), the device inherits the template settings and will use the values that are defined in the template.
Depending on the permission settings, the template settings might be overridden in the device configuration.
Please read this chapter for an introduction to the template concept and refer to Chapter 5 for detailed information on templates and inheritance.
For information on how to create, delete, or edit templates please refer to Chapter 3.2.

The following screenshot shows the *Template Properties Dialog*:

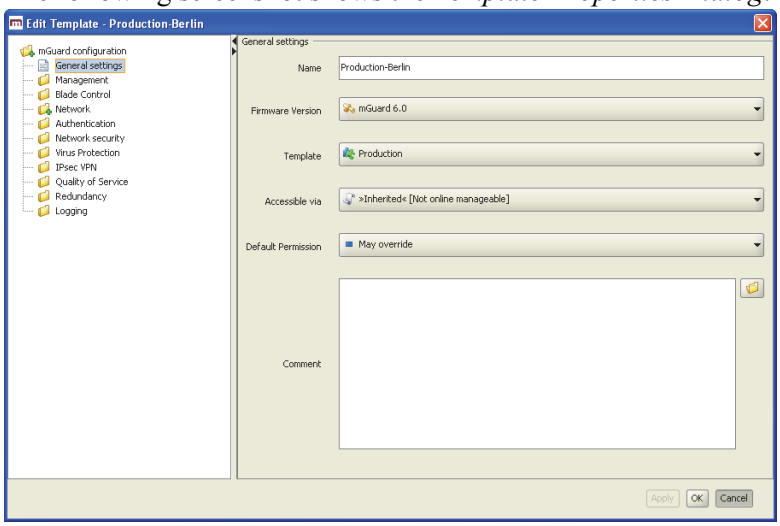


Figure 30: The mdm Template Properties Dialog

General settings

Similar to the *Device Properties Dialog* (see Chapter 4.3) the *Template Properties Dialog* contains a menu corresponding to the mGuard's Web GUI structure on the left side of the window.
Additionally the *Template Properties Dialog* contains the entry **General settings** for the configuration of parameters related to mdm:

Name

The name of the template.

Firmware version

Since different firmware versions of the mGuard have different sets of variables, the firmware version (or variable set) the template should use, has to be selected here.

☞ It is not possible to downgrade to an older release. So please be very careful when changing the firmware version. See Chapter 5.2.2 for more details.

☞ For more information on how to manage firmware upgrades of your devices with mdm please refer to Chapter 3.12.

Template

The parent template of this template.

Accessible via

This is the address used by the mdm server to access the mGuard for an SSH push of the configuration or to open the web interface. Please refer to Chapter 3.9 for more information on the upload procedure. The following values are available for **Accessible via**:

- **Not online manageable**
  The device is not managed via SSH push.
- **Internal interface in auto stealth mode [1.1.1.1]**
  mdm accesses the mGuard using the address 1.1.1.1 (address of internal interface in automatic stealth mode).
- **Stealth management address**
  mdm accesses the external or internal interface of the mGuard in stealth mode.
- **First external IP address**
  mdm accesses the external interface of the mGuard in router mode.
- **First internal IP address**

mdm accesses the internal interface of the mGuard in router mode.

- Custom value
  A custom value might be required to access the mGuard in NAT scenarios. If necessary, you can additionally specify a port number:
  <IPaddress>:<port number> or
  <hostname>:<port number>

Default Permission

The permission mdm uses for variables set to **Inherited** when a device or template inherits from this template. The following permissions can be set:

- **May override**
  Variables set to **Inherited** have **May override** permission, i.e. they can be set in the inheriting device or template.
- **May append**
  Table variables set to **Inherited** have **May append** permission, i.e. rows can be appended in the inheriting device or template, but existing rows cannot be changed. Other variables set to **Inherited** have **May override** permission, i.e. they can be set in the inheriting device or template.
- **No override**
  Variables set to **Inherited** have **No override** permission, i.e. they cannot be set in the inheriting device or template.

Comment

An additional optional comment which is also shown in the template table of the main window.

4.2.1 Template configuration

As explained above, the navigation tree on the left side of the *Template Properties Dialog* resembles the mGuard menu structure.
Figure 31 shows an example of the configuration for the external interface.

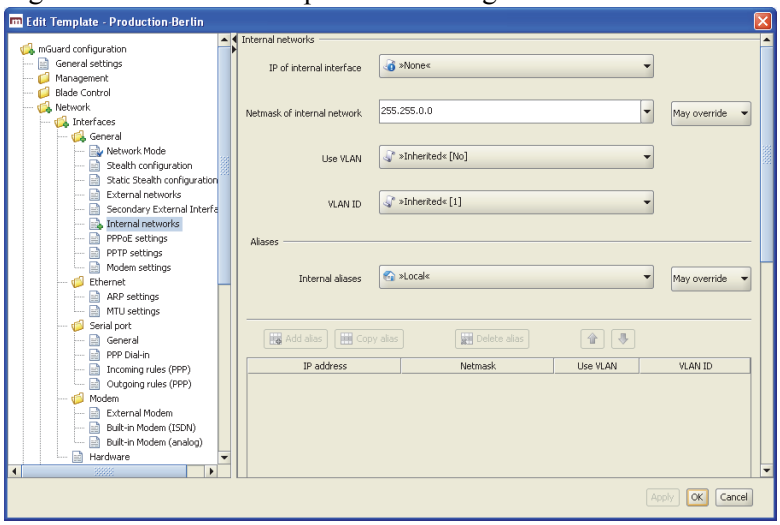


Figure 31: Template configuration

Compared to the *Device Properties Dialog* there are additional settings in the template configuration which are explained in the following sections.
For detailed information on the template and inheritance concept please refer to Chapter 5.

***None* value type**

In the template **None** can be selected as value, as you can see in the variable **IP of internal interface** in Figure 31. This means that the template designer does not want to define a value in the template, but wants to make sure the value is overridden in an inheriting template or device. Any attempt to upload a device in which a **None** value has not been overridden or has been overridden with a **Local** value results in an error.

Permission setting

In Figure 31 the variable **Netmask of internal network** has an additional permission setting. The permission controls whether and how an inheriting device or template can override the settings. The permission settings can be assigned on a per-variable basis.

☞ Please note that the permission combo box is not visible if **Inherited** or **None** is selected as value.

The following permissions can be selected:

May override

The value can be changed (overridden) in an inheriting template or device.

No override

The value cannot be changed in an inheriting template or device.

May append

This setting is only available for tables (e.g. firewall rules). If a table variable is set to **May append**, additional table rows can be appended in an inheriting device or template, but the inherited rows cannot be changed or removed.
If **Local** is selected as value and **May append** as permission, new entries can be added in an inheriting device or template, as well as on the mGuard by the *netadmin* user.

4.3 The *Device Properties Dialog*

The *Device Properties Dialog* allows to configure the mGuard variables and their associated settings for a device.

For information on how to create, delete or edit devices please refer to Chapter 3.2.

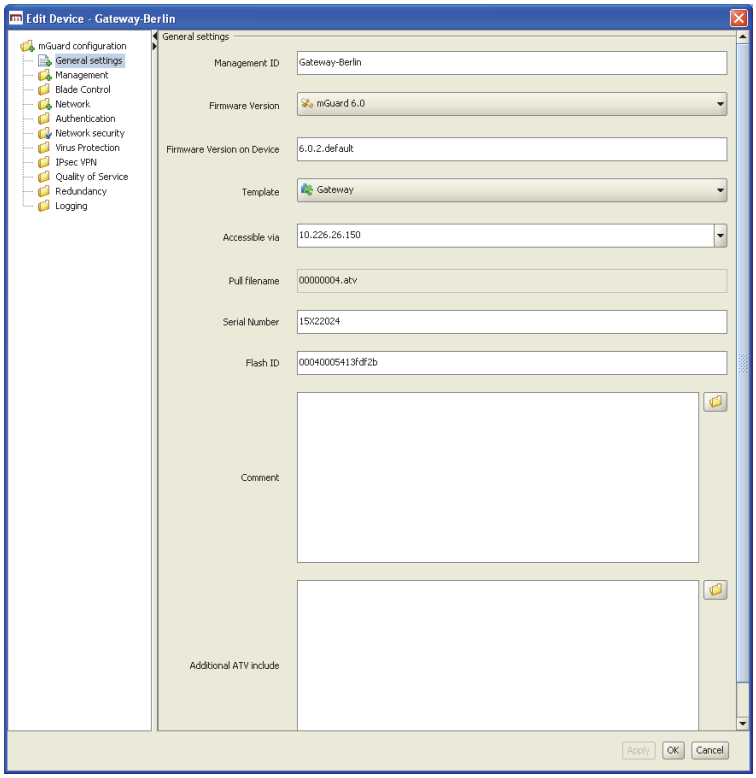


Figure 32: The mdm Device Properties Dialog

Similar to the *Template Properties Dialog* (see Chapter 4.2) the *Device Properties* dialog contains a navigation tree on the left side that resembles the menu structure of the mGuard Web GUI. The navigation tree allows you to conveniently navigate to each mGuard variable.

General settings

The *Device Properties Dialog* contains the entry **General settings** for the configuration of additional parameters related to mdm. The following parameters can be set in the **General settings**:

Management ID

This ID is used to identify the device within mdm. The Management ID must be unique.

Firmware Version

Since different releases of the mGuard software have different sets of variables, the firmware version corresponding to the installed firmware on the mGuard has to be selected here.

☞ It is not possible to downgrade to an older release. So please be very careful when changing the firmware version. See Chapter 5.2.2 for more details.

☞ For more information on how to manage firmware upgrades of your devices with mdm please refer to Chapter 3.12.

Firmware Version on Device

This field represents the firmware version currently installed on the device. It can be manually set, but is overridden with the value found on the device every time a push upload is performed or a pull feedback is received.

Template

The parent template of the device.

Accessible via

This is the address used by the mdm server to access the mGuard for an SSH push of the configuration or to open the web interface. Please refer to Chapter 3.9 for more information on the upload procedure. The following values are available for *Accessible via*:

- **Not online manageable**
  The device is not managed via SSH push.
- **Internal interface in auto stealth mode [1.1.1.1]**
  mdm accesses the mGuard using the address 1.1.1.1 (address of internal interface in automatic stealth mode).
- **Stealth management address**
  mdm accesses the external or internal interface of the mGuard in stealth mode.
- **First external IP address**
  mdm accesses the external interface of the mGuard in router mode.
- **First internal IP address**
  mdm accesses the internal interface of the mGuard in router mode.
- Custom value
  A custom value might be required to access the mGuard in NAT scenarios. If necessary, you can additionally specify a port number:
  <IPaddress>:<port number> or
  <hostname>:<port number>

Pull filename (read only)

If the configuration is exported to the file system, a unique ID, which is automatically assigned and cannot be changed, is used as name for the configuration file. The filename is shown in this field. Optionally, additional export files following a different naming scheme can be generated; please refer to Chapter 2.6 for more information.

Serial number

The serial number of the device. The serial number is required for the license handling. It can be manually set, but is overridden with the value found on the device every time a push upload is performed or a pull feedback is received. If no push upload is ever performed and no pull feedback is ever received (e.g. in a usage scenario where the exported configuration profiles are installed manually on the devices), the serial number has to be entered here if you would like to create pull configuration filenames containing the serial number.

Flash ID

The flash ID of the device. The flash ID is required for the license handling. This field can be manually set, but is overridden with the value found on the device every time a push upload is performed or a pull feedback is received.

Comment

An optional comment.

Additional ATV include

This is a text field for additional settings that should be included in the configuration file of the mGuard. The input has to adhere to the mGuard configuration file conventions. You can also import the contents of a text file in the field by selecting a file with the *File Chooser* icon.

☞ Please note that the included configuration will be appended to the generated mdm settings, and therefore settings for the same variable in the include field will override settings generated by mdm.

4.4 The *Pool Properties* Dialog

The *Pool Properties Dialog* allows to define value pools, which can be used to automatically configure certain variables (e.g. the virtual address for VPNs). Currently mdm allows to define address range pools (CIDR notation), see below for an example.

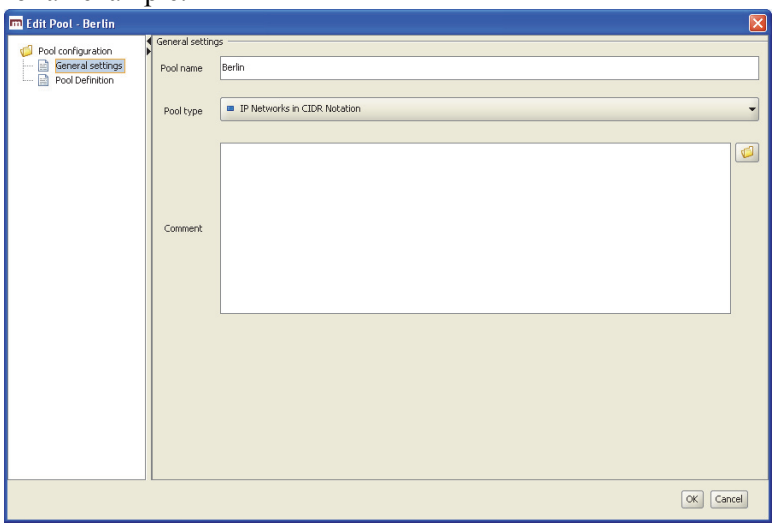


Figure 33: The mdm Pool Properties Dialog

General settings

The entry **General settings** contains the following parameters for the pool:

Name

A name for the pool. This name will be used when referencing the pool in a variable (see section *Pool values usage in variables* below).

Pool type

Currently only the pool type *IP Networks in CIDR Notation* is available.

Comment

A comment (optional).

Pool definition

The entry **Pool Definition** allows to define the value range of the pool and the address range of the values to be taken out of the pool. The following figure contains an example of a pool definition:

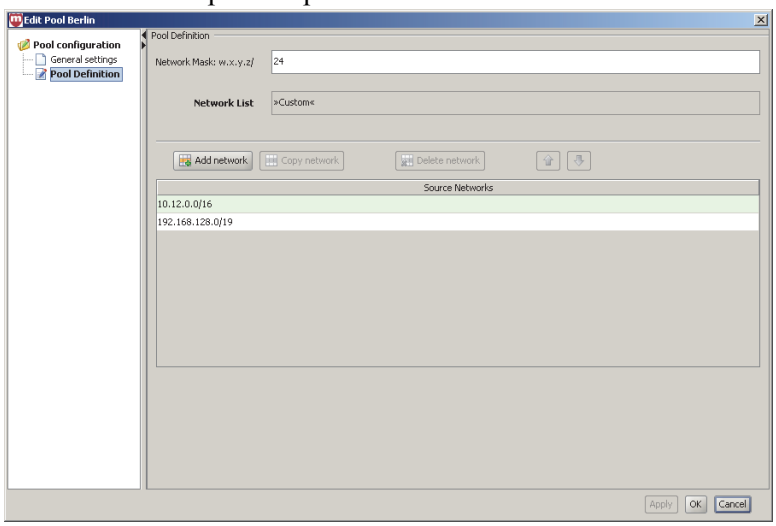


Figure 34: Definition of a CIDR pool

The CIDR pool in the example contains all addresses defined in the table **Network List**. The field **Network Mask** defines the range of single values to be taken out of the pool, i.e. when using this pool in a variable, mdm will automatically assign an IP address range with a mask of 24 out of the available Source Networks to that variable.
E.g. if the pool is used for the template variable **Remote network** (in a VPN connection), then mdm will automatically assign a value to the variable **Remote network** of all devices using the respective template. The pool overview table in the main window shows how many values have been taken out of the pool (*Use count*) and how many values are still available in the pool (*Available count*)

☞ Please note that once defined, it is not possible to change or delete the source address ranges and the network mask in the pool any more, e.g. it is not possible to decrease the network range 10.12.0.0/16 to 10.12.0.0/19 in the example above. It is only possible to add further ranges to the pool, i.e. increase the pool value range. Please carefully plan the definition of the pool ranges in advance.

Pool value usage in variables

Pool values can only be used in templates. For certain variables you can choose the pool you would like to use from the drop down box, e.g. in Figure 35 a number of pools (*London, New York, Paris,* etc.) are available to be used for the variable *IP of external interface*. Only pools that match the variable type (e.g. CIDR pool and variable of type IP address) are shown in the drop down box. If a pool is used in a template, no value is assigned to the respective variable, the pool is only referenced at this point. Therefore the *Reference count* in the pool table will be increased by one. If a value is assigned to a variable (which happens

on device level, not on template level) the *Use count* is increased by one. This assignment happens automatically either if the *Device Properties Dialog* for the respective device is opened, or if the configuration for the device is uploaded to the mGuard.

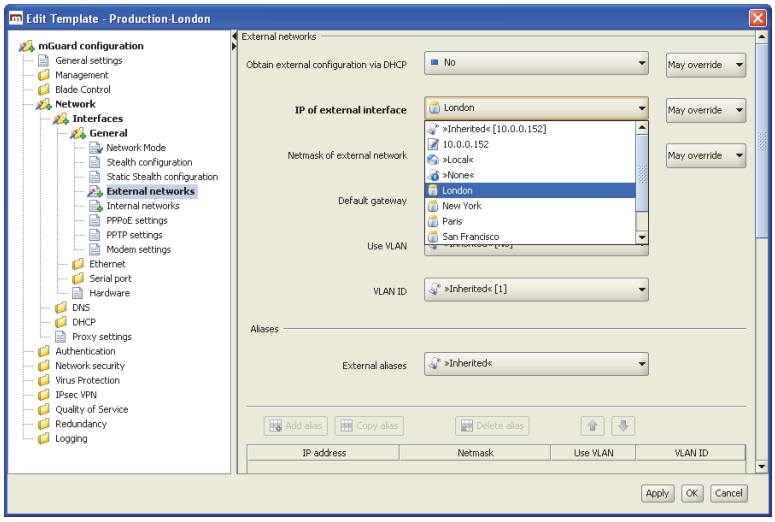


Figure 35: Usage of pool values

The following should be kept in mind when working with pools:

- In a variable that requires an IP address (not an IP network) only pools with a network mask of *32* can be referenced.
- If you decide to override a pool value in a device, the assigned pool value is not returned to the pool (i.e. the *use count* is not decreased), but remains assigned “in the background”, in case you decide to use the inherited value again.
- Pools must be large enough to provide a value for every device that inherits from the template in which the pool is referenced, even if some of the devices override their respective pool value (see above).

4.5 VPN configuration

With mdm you can easily generate the configuration for a large number of VPN tunnels. In general, the information contained in Chapter 4.1, Chapter 4.2, Chapter 4.3 and Chapter 5 applies also to the VPN configuration. But VPNs require some special settings to be taken into consideration, which are explained in this chapter, e.g. the automatic configuration of the VPN peer. You can find the VPN configuration in the node **IPsec VPN** of the navigation tree.

Adding and editing VPN connections

To add, change or delete VPN connections, please open the node **IPsec VPN » Connections**. To create a new connection, create a new table row (see Chapter 4.1, *Modifiying table entries*). As soon as you create a connection, it appears as node in the navigation tree. To edit the connection, open its node in the navigation tree and navigate to the desired settings. The structure of the connection node resembles the menu structure on the mGuard.

- The connection table is read-only, i.e. you have to navigate to the respective node to make changes to the connection, e.g. change the name of the connection or disable a connection.
- Please note that the permission setting of the connection table in a template applies to the table only, and not to the contents of the connections. If you set the table to *No override*, the settings of the VPN connection can still be modified on a device which uses this template,

but the user on the device level is not allowed to add further connections to the table.

Automatic configuration of the VPN peer

You can automatically generate the VPN configuration for the peer device (see Figure 36): Place the cursor in the field **Peer device** and press the *Cursor Down* key. A list of available devices appears. You can limit the number of devices in the list by entering the first characters of the Management ID of the desired device. If you select a device, the VPN configuration for this device will be automatically generated.

- ☞ Not all settings of the peer can be automatically generated, therefore you have to enter parts of the configuration manually. Please check the sub-nodes of the VPN connection for those settings, they are in the relevant subnodes separated from the other settings by the text **Configuration of peer device** (for an example see Figure 36).
- ☞ The automatically generated VPN connections show up as read-only in the peer connection table, i.e. you cannot change the configuraton on the peer side.
- ☞ If the VPN gateways have different firmware versions the configuration of a peer is only possible in the *Properties Dialog* of the device with the *older* firmware version. If you configure the peer in the *Properties Dialog* of the device with newer firmware the connection will not be generated in the device with the older firmware. There will be no error or warning displayed.
- ☞ The automatically generated VPN connections can be used as alternative to the mGuard *Tunnel Group* feature (mGuard 5.0 or newer), see comments in section *Hints for VPN configurations* below.

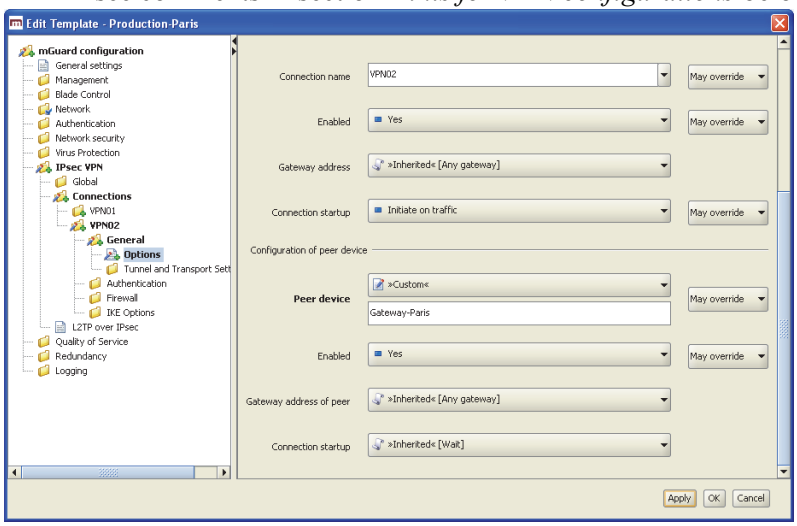


Figure 36: Automatic configuration of VPN peer

Setting VPN identifiers automatically

The local and the remote machine certificate are known to mdm in many typical usage scenarios (when VPN configuration for the peer device is generated by mdm). mdm can make use of this information to set the **Local VPN Identifier** and the **Remote VPN Identifier** variables automatically, i.e. derive the identifiers from the known certificates. It is necessary to set these variables when CA certificates are used to authenticate VPN connections.

To make use of this feature, open the **IPsec VPN » Connections » *Connection Name* » Authentication » VPN Identifiers** node and set the variable **Set VPN Identifiers automatically** to **yes**. In this mode, the **Local VPN Identifier** and the **Remote VPN Identifier** variables are ignored; the identifiers are derived from the cerificates.

Copying firewall rules

The firewall tables within VPN connections contain a **Copy from Main** button. Clicking this button copies the content of the corresponding firewall table for non-VPN traffic (i.e. if the current firewall table is for incoming traffic, the incoming firewall table for non-VPN traffic is copied; likewise for outgoing traffic).

A separate background color is used to indicate which firewall rules have been copied. The background color is cleared once a different navigation tree node is opened.

Hints for VPN configurations

These hints are useful if the tunnel group feature is not used and the VPN connections are explicitly defined:

- ☞ In 1:N VPN configurations it is recommended to define the VPN connection in a template and select the central device in the **Peer devic**e field (See section *Automatic configuration of peer* above). If you assign this template to the devices mdm will automatically generate the N connection configurations for the central device.
- ☞ In a 1:N VPN configuration it is required for the configuration of the peer to specify the gateway address of the current device (see Figure 36, **Configuration of peer device » Gateway address of peer**). If certificates are used *%any* (as shown in Figure 36) can be used as address in the template, but if PSK authentication is used, *%any* is not allowed. If PSK authentication is used, the external address (if no NAT us used) has to be entered into the field **Configuration of peer device » Gateway address of peer** for each device.

4.6 Managing X.509 certificates

The functionality of the certificate management depends on the mGuard release. Beginning with mGuard firmware release 5.0 it is possible to:

- manage multiple machine certificates (prior to release 5.0 only one machine certificate was supported)
- manage CA certificates (prior to release 5.0 CA certificates were not supported)
- manage connection certificates at a central location (prior to 5.0 the connection certificate was part of the VPN connection only; beginning with 5.0 the connection certificates can be managed centrally and then be referenced for SSH or HTTPS authentication)
- manage CRLs (prior to release 5.0 CA CRLs were not supported)

Exporting Certificates

You can export certificates, e.g. if you would like to use the machine certificate as connection certificate for a VPN connection. To export a certificate please navigate to the respective certificate table (see below for more information) and click on the **Export** button. You can export the certificate to a folder of your choice.

4.6.1 Machine certificates

You can either import a machine certificate (*PEM* or *PKCS#12* file), request a certificate from the mdm CA, request a certificate from any CA supporting the Simple Certificate Enrollment Protocol (SCEP), or manually enrol certificates.

- ☞ In a template it is not possible to request or import a machine certificate. (It is only possible to import the connection certificate of the peer).
- ☞ The file to be imported can be in *PEM* format containing the unencrypted private key and the certificate, or in *PKCS#12* format protected by a password. The file type is automatically detected. When importing a *PKCS#12* file, a dialog asking for the password is displayed.

You can convert a *PKCS#12* file to *PEM* using the command:
`openssl pkcs12 -in inputfile.p12 -nodes -out outputfile.pem`

☞ When SCEP is used, the CA server must be configured to issue certificates immediately. Pending requests are not supported.

Requesting a machine certificate

☞ In order to request a certificate from the mdm CA, the CA component has to be installed (see Chapter 2.8).

Prior to requesting a certificate make sure that the certificate attribute fields contain the desired values (for mGuard firmware 4.2 navigate to **IPsec VPN » Global » Machine certificate » Certificate attributes**, for mGuard firmware 5.0 or newer navigate to **Authentication » Certificates » Certificate settings** and **Certificate attributes**).

To request a certificate select one or more devices in the device overview table and select **Certificate Handling » Request Additional Certificate** or **Certificate Handling » Request Replacement Certificate** from the context menu. The difference is that **Request Additional Certificate** will append the new certificate to the list of existing certificates while **Request Replacement Certificate** will replace the existing certificates with the new one, so that the device ends up with a single machine certificate.

The mdm server will request certificate(s) from the CA and will assign them to the device(s).

☞ SCEP requires that a one-time challenge password is entered for each certificate request. Therefore, certificate requests can only be performed for a single device if SCEP is used. The mdm client will open a dialog window in which to enter the challenge password; please consult the documentation of your CA server on how to obtain the password.

☞ OCSP and CRLs are not supported by mGuard 4.2. Nevertheless, if you would like to use firmware releases newer than 4.2 with CRL/OCSP support, you should configure values for these attributes.

Importing a machine certificate (mGuard firmware 4.2)

To import a certificate navigate to **IPsecVPN » Global » Machine certificate » Machine certificates** and click on the **Import** button (the **Import** button is only enabled if **Custom** or **Custom+Locally appendable** is selected as value for the machine certificate table). Select the file containing the machine certificate and click on **Open**. The machine certificate is subsequently shown in the table if the import was successful, otherwise an error message will be displayed.

☞ Only the first entry of the machine certificate table is used as machine certificate.

Importing a machine certificate (mGuard firmware 5.0 or newer)

To import a certificate navigate to **Authentication » Certificates » Machine Certificates** and click on the **Import** button (the **Import** button is only enabled if **Custom** or **Custom+Locally appendable** is selected as value for the machine certificate table). Select the file containing the machine certificate and click on **Open**. The machine certificate is subsequently shown in the table if the import was successful, otherwise an error message will be displayed.

Deleting machine certificates

To delete a machine certificate, navigate to **Authentication » Certificates » Machine Certificates,** select the certificate in the certificate table and click on the **Delete certificate** button.

☞ Deleting a certificate does not automatically revoke the certificate.

Revoking machine certificates

To revoke a machine certificate, navigate to **Authentication » Certificates » Machine Certificates,** select the certificate and click on the button **Revoke certificate**. This button is enabled only if exactly one machine certificate is selected. After revoking a certificate the text **** REVOKED **** is automatically shown in the corresponding info field of the table. Any time a

certificate is revoked, the mdm CA exports a new file containing all revoked certificates of this issuer. For more information on the export of CRL files please refer to Chapter 2.8.5.

☞ SCEP does not support revoking certificates.

☞ CRLs are only supported by mGuard firmware 5.0 and newer.

☞ Revoking a certificate does not delete the certificate from the table.

Manual certificate enrollment

If certificates issued by a CA are to be used, but requesting them online (from the mdm CA or via SCEP) is not an option, mdm supports manual certificate enrollment. Any CA software or service can be used. Follow these steps to enrol certificates manually for a number of devices:

1. Select one or more devices in the device overview table and select **Certificate Handling » Issue and Export Certificate Requests** from the context menu.
2. A file selection dialog opens. Select a directory and click on the **Choose** button.
3. mdm will generate private keys and certificate requests for the devices. The private keys are (invisibly) associated with the respective devices. The certificate requests are stored in the selected directory as PEM encoded files (one request per device).
4. Import the certificate requests into the CA and let the CA issue certificates. Please consult the documentation of your CA software or service for details of how to do this.
5. Select **New » Import X.509 Certificates** from the main menu.
6. A file selection dialog opens. Select the certifictate files issued by the CA.
7. Select from the **Import Settings** whether to add the certificates or replace any certficate that may already exist in a device. Click on the **Choose** button.
8. mdm automatically associates the certificates with the correct devices and stores them in the machine certificate tables.

   ☞ Only one pending certificate request per device is stored. If the **Certificate Handling » Issue and Export Certificate Requests** action is invoked more than once without importing the resulting certificates, only the certificates from the last invocation can be imported.

4.6.2 CA certificates (mGuard firmware 5.0 or newer)

Importing CA certificates

Beginning with mGuard release 5.0 CA certificates (root or intermediate) are supported. To import a CA certificate navigate to **Authentication » Certificates » CA Certificates** and click on the **Import** button (the **Import** button is only enabled if **Custom** or **Custom+Locally appendable** is selected as value for the CA certificate table). Select the file containing the CA certificate and click on **Open**. The CA certificate is subsequently shown in the table if the import was successful, otherwise an error message will be displayed.

4.6.3 Remote certificates (mGuard firmware 5.0 or newer)

Importing remote certificates

To import a remote certificate navigate to **Authentication » Certificates » Remote Certificates** and click on the **Import** button (the **Import** button is only enabled if **Custom** or **Custom+Locally appendable** is selected as value for the remote certificate table). Select the file containing the remote certificate and click on **Open**. The remote certificate is subsequently shown in the table if the import was successful, otherwise an error message will be displayed.

4.6.4 Connection certificates

Importing connection certificates

The connection certificate can only be imported in a VPN connection. To import the certificate navigate to **IPsec VPN » Connections » *Connection Name* » Authentication.** To import a certificate select **Custom** as value for the **Remote X.509 certificate** and click on the icon. Select the file containing the certificate and click on **Open**. Subsequently the content of the file is shown in the certificate field. The validity of the data is checked when uploading the configuration to the mGuard.

4.7 Using X.509 certificates (mGuard firmware 5.0 or newer)

The certificates which are managed in the tables discussed in Chapter 4.6 can be used for the configuration of SSH and HTTPS authentication. The usage is exemplarily explained for the SSH authentication. Please navigate in the *Device Properties Dialog* to **Management » System settings » Shell access » X.509 authentication**. To use a certificate, e.g. a CA certificate, you have to select **Custom** for the CA certificate table and then click on **Add certificate**. Please enter the *short name* of the certificate as specified in the CA certificate table in **Authentication » Certificates » CA Certificates**. mdm does not check whether the *short name* of the certificate exists.

4.8 The VPN Group Properties Dialog (Meshed VPN networks)

The member devices of a VPN group form a meshed VPN network: For each member device, mdm generates a VPN connection (referred to as a VPN group connection) to every other member device. A device can be a member of multiple VPN groups. If this results in multiple VPN connections between the same two devices, mdm generates only one such connection. VPN groups are not available for firmware versions earlier than 6.0.

The *VPN Group Properties Dialog* allows to configure common variables used in all VPN connections within the group.

For information on how to create, delete or edit VPN groups, and how to add or remove member devices, please refer to Chapter 3.6.

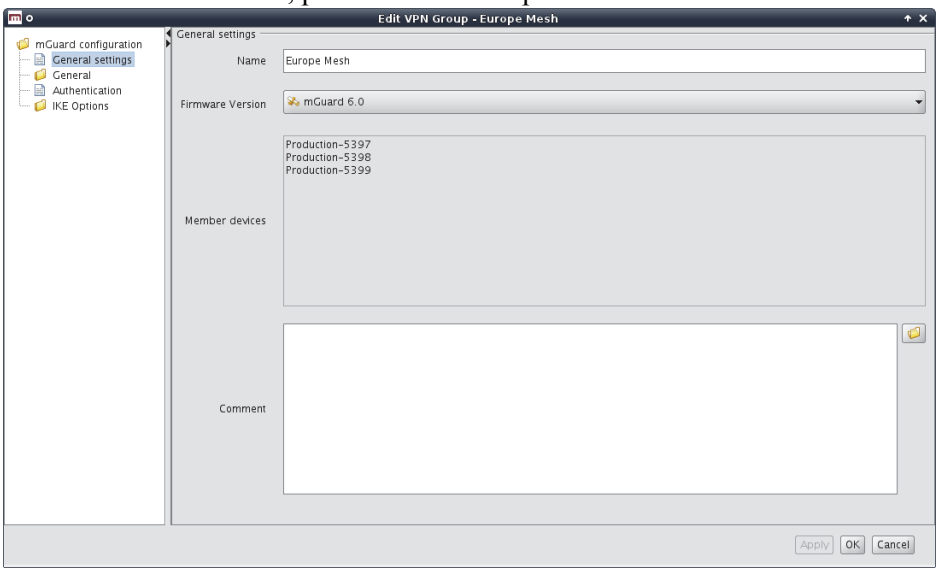


Figure 37: The mdm VPN Group Properties Dialog

Similar to the *Device* and *Template Properties Dialogs* the *VPN Group Properties Dialog* contains a navigation tree on the left side. It allows you to conveniently navigate to each variable.

General settings

The *VPN Group Properties Dialog* contains the entry **General settings** for the configuration of additional parameters related to mdm. The following parameters can be set in the **General settings**:

Name

The name is used to identify the VPN group within mdm. It must be unique.

Firmware Version

Since different releases of the mGuard software have different sets of variables, the firmware version corresponding to the installed firmware on the mGuard has to be selected here.

☞ It is not possible to downgrade to an older release. So please be very careful when changing the firmware version. See Chapter 5.2.2 for more details.

☞ Only devices with a firmware version equal to or newer than the firmware version of the VPN group can become its members.

Member devices (read only)

The devices which are currently members of the VPN group.

Comment

An optional comment.

VPN group connections

When generating VPN group connections, mdm combines the variables in the VPN group with additional variables in the device. While the variables in the VPN group are common to all connections in this group, the additional variables in the device are specific to the device, but common to all VPN group connections of the device.

The VPN group contains the following variables:

- General VPN settings
- Protocol settings
- Authentication settings
- IKE options

Devices and templates contain variables under the **IPsec VPN » VPN Group Configuration** node which are used when mdm adds VPN group connections to a device:

- Tunnel settings
- NAT settings
- Firewall settings

The local VPN network

The local VPN network to be used in VPN group connections can either be specified in the template or device (**IPsec VPN » VPN Group Configuration » Tunnel Settings » Local**), or, if the device is operated in router mode, it can be automatically derived. If the **IPsec VPN » VPN Group Configuration » Tunnel Settings » Use first internal address as local VPN network in router mode** variable is set to **Yes**, mdm uses the first internal address and associated netmask, so that the corresponding local network is visible through the VPN tunnel. The setting has no effect in stealth mode, i.e. if the device is operated in stealth mode, the local VPN network must always be specified.

Local 1:1 NAT

VPN group connections can be configured to perform 1:1 NAT on local addresses. None of the other NAT mechanisms for VPN connections are available in VPN group connections.

Local 1:1 NAT is enabled by setting the **IPsec VPN » VPN Group Configuration » NAT » Enable 1:1 NAT of local addresses** variable to **Yes**. The local network within the tunnel must be specified.

☞ Please note that the network *within the tunnel* (i.e. the network addresses as seen by the peer) is specified in the 1:1 NAT settings. This is different

from the mGuard Web GUI where the network *outside of the tunnel* (i.e. the network addresses as seen from the local network) is specified in the 1:1 NAT settings.

Extended firewall rules

The firewall rules under the **IPsec VPN » VPN Group Configuration** node contain additonal **Combine** fields associated with the **From IP** and **To IP** addresses or networks. If a **Combine** field is set to **No**, the corresponding address or network is used in the VPN group connection without modification.

If a **Combine** field is set to **Yes**, the address or network entered in the table is combined with the local or remote VPN network to calculate the network used in the VPN group connection.

- In the incoming firewall rules, the **From IP** field is combined with the remote VPN network and the **To IP** field is combined with the local VNP network.
- In the outgoing firewall rules, the **From IP** field is combined with the local VPN network and the **To IP** field is combined with the remote VNP network.

The value of the **From IP** or **To IP** field is combined with the VPN network by adding the addresses octet-wise, i.e. each octet is added individually. If the result of adding two octets overflows (i.e if it is greater than 255), the value 256 is subtracted (i.e. the addition “wraps around”). The network mask of the value of the **From IP** or **To IP** field (or 32 if the field does not contain a network mask) is applied to the result.

Examples:

- If the **From IP** or **To IP** field has the value 0.0.78.0/24, and the VPN network is 10.6.0.0/16, the combined value is 10.6.78.0/24.
- If the **From IP** or **To IP** field has the value 0.1.78.0/24, and the VPN network is 10.6.0.0/16, the combined value is 10.7.78.0/24.

4.9 Rollback support

Configuration rollback is supported on devices with firmware version 5.0 or newer. A rollback is performed by the device if it cannot access the configuration pull server after applying a pull configuration (this is interpreted by the device as misconfiguration). To enable rollback for a device please navigate in the *Properties Dialog* to **Management » Configuration Pull** and set the option **Rollback misconfigurations** to **Yes**.

4.10 Redundancy mode

If a device or template is in redundancy mode, it represents a pair of redundant mGuards (i.e. two physical devices). Settings and configuration variables which must or may be different for the two physical devices of a redundant pair can be set separately.

Additional navigation tree nodes and variables are visible in the *Device* and *Template Properties Dialog* in redundancy mode. Nodes and variables prefixed with **Device#2** are used for the second device while those without prefix are used for the first device.

Separate settings

The following settings exist separately for the physical devices, but are not normally set by the user:

- **Firmware Version on Device**
- **Pull filename**
- **Serial Number**
- **Flash ID**

The following variables *must* be set to different values for the physical devices:

- The external and internal network settings in router mode.
- The stealth management address settings in stealth mode.

- The IP settings for the dedicated redundancy state synchronization interface (if this interface is used).

The following variables *may* be set to different values for the physical devices:

- The hostname.
- The SNMP system name, location, and contact.
- The MTU settings.
- The http(s) proxy settings.
- The passwords of the mGuard users.
- The Quality of Service settings.
- The redundancy priority.
- The redundancy connectivity check settings.
- The remote logging settings.

Upload

When an upload to a redundant device pair is initiated, the two configurations are uploaded to the physical devices. The two uploads to the mGuards forming a redundant pair are never performed simultaneously (but may be performed simultaneously with uploads to other devices). An upload to a redundant pair is considered successful once the upload to both physical devices has succeeded.

Pull export

A pull configuration export for a redundant device pair creates two configuration profiles. The filename of the profile for the second device has **_2** appended to the base name.

5 Working with templates

Changes made to a template can potentially affect a large number of devices or other templates. Therefore please keep the following rules in mind when working with templates:

- Before making changes to a variable in a template, make sure that the effect on inheriting templates or devices is really desired.
- In particular, changes to a variable permission can have an irreversible effect on inheriting templates or devices. E.g. if a permission is changed from **May override** to **No override**, the value of the variable is discarded in all inheriting templates and devices.
- Templates that are still assigned to devices or other templates cannot be deleted.

This chapter gives more detailed information on the template mechanism.

5.1 Inheritance

Templates are the means to efficiently configure a large number of devices. Templates contain the common aspects of a group of devices or a group of child templates. By assigning a template to a child (this may be a device or another template) the child "inherits" the parent template's settings and may optionally override some of the settings (if the permission in the parent template allows this). Any change made to the parent template will potentially have an impact on all inheriting templates and devices, depending on the setting of the value and permission in the parent template.

The permission setting in a template limits the choices in inheriting templates and devices.

Whether or not a child inherits settings from an ancestor template is indicated by an icon in front of the variable name in the *Properties Dialog*. If no icon is shown, then either there is no template assigned, or the variable has the value **Inherited** in all ancestor templates, i.e. no restrictions are defined for this variable.

According to the permissions listed in Chapter 4.2.1 the following icons are shown in front of the variable name:

May override.

No override.

May append (tables only).

No value defined (value = **None**), i.e. the value has to be set in the *Device Properties Dialog* or in one of the intermediate templates.

The following figures illustrate the inheritance mechanism. Figure 38 shows the settings for the *DHCP server options* in the parent template.

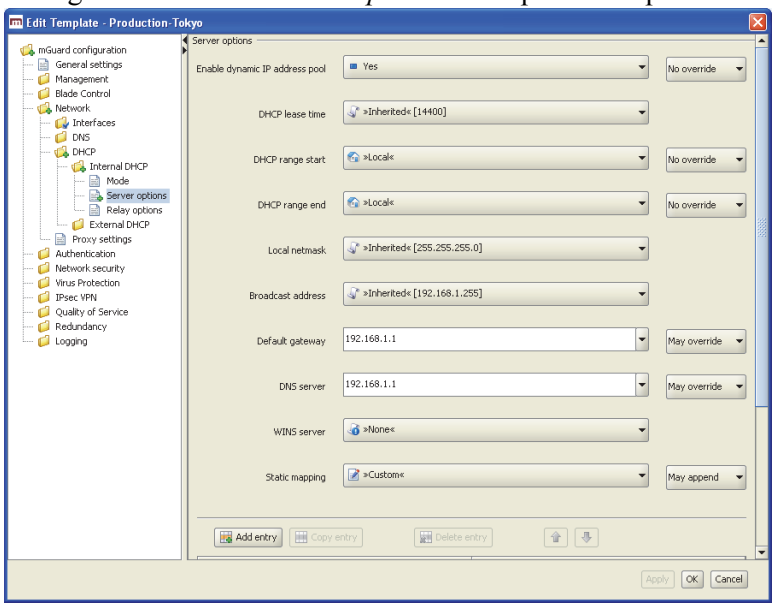


Figure 38: Settings in the parent template

Figure 39 shows the settings in the device configuration (child). They are the result of values and permissions inherited from the parent template and modifications made in the device.

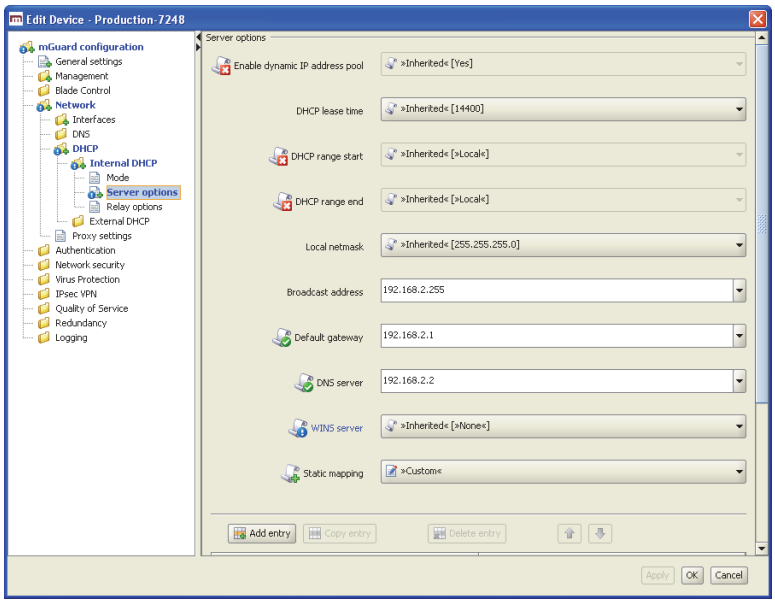


Figure 39: Settings in the inheriting device

Enable dynamic IP address pool

This variable is set to **Yes** in the template and the permission is set to **No override**. Therefore the value of the variable cannot be changed in the device configuration. This is indicated by the disabled controls and by the icon in front of the variable name in the *Device Properties Dialog*.

DHCP range start, DHCP range end

These variables are set to **Local** and the permission is set to **No override**, i.e. the **Local** setting cannot be changed in the device configuration. These values have to be set by the *netadmin* of the mGuard and are not managed by mdm.

Local netmask, Broadcast address

There are no restrictions for these variables defined in the template, indicated by the missing icon in front of the variable name in the *Device Properties Dialog*. In the example the device configurator decided to use a custom value for **Broadcast address** and the (inherited) default value for **Local netmask**.

Default gateway

The value of this variable is set in the template and the permission is set to **May override**. Therefore the value of the variable can be changed in the device configuration. This is indicated by the enabled controls and by the icon in front of the variable name. In the example the value from the template is overridden with a custom value.

DNS server

The value of this variable is set in the template and the permission is set to **May override**. Therefore the value of the variable can be changed in the device configuration. This is indicated by the enabled controls and by the icon in front of the variable name. In this example the value from the template is overridden in the device configuration with a custom value.

WINS server

The value of this variable is set to **None** in the template. Therefore a value for this variable ***has to be assigned*** in the device configuration. This is indicated by the icon in front of the variable name and the blue-colored label. If a device for which **None** values have not been assigned is uploaded, an error occurs.

Static mapping

In the template, the table **Static mapping** is set to **Custom** and its permission is set to **May append**. As Figure 39 shows, rows can be added to the table in the device configuration after switching the table variable to **Custom**. Rows inherited from the template cannot be changed.

5.2 Miscellaneous

5.2.1 Complex table variables and permissions

The permission setting for complex table variables (see Chapter 4.1) in the parent template applies to the table itself, but not to the contents of the rows. If the table is set to **No Override**, it is not possible to add or delete rows in the child configuration, but it might be possible to change the value of variables in the inherited rows in the child. Each variable of a row (node) has a separate permission setting in the parent template that determines whether the variable can be overridden in the child. The permission setting of the table and the permission setting of a single variable within the table are completely independent.

5.2.2 Firmware release settings and inheritance

Certain restrictions apply to the **Firmware Version** setting in the **General Settings** of the child and the parent template:

- A child cannot inherit from a parent template that has a newer firmware version than the child itself.
- It is possible to change the firmware version of a parent template to a newer version only if all childs inheriting from the parent template are already set to the new firmware version.

6 Configuration history

mdm keeps track of mGuard device configurations in the configuration history. Whenever a change is made to a device, template, or VPN group configuration, a new history entry is automatically created for each device that changes as a result.

Each device has its own independent history. When a device is deleted, its associated history is deleted as well.

☞ The history stores configurations as they are uploaded to the mGuards. Variable permissions and template inheritance relations are not part of the history.

6.1 The configuration history dialog

To access a device's configuration history, select the device in the device overview table and activate the **Show Device Configuration History** option in the context menu. This opens the configuration history dialog which contains a list of history entries for the selected device.

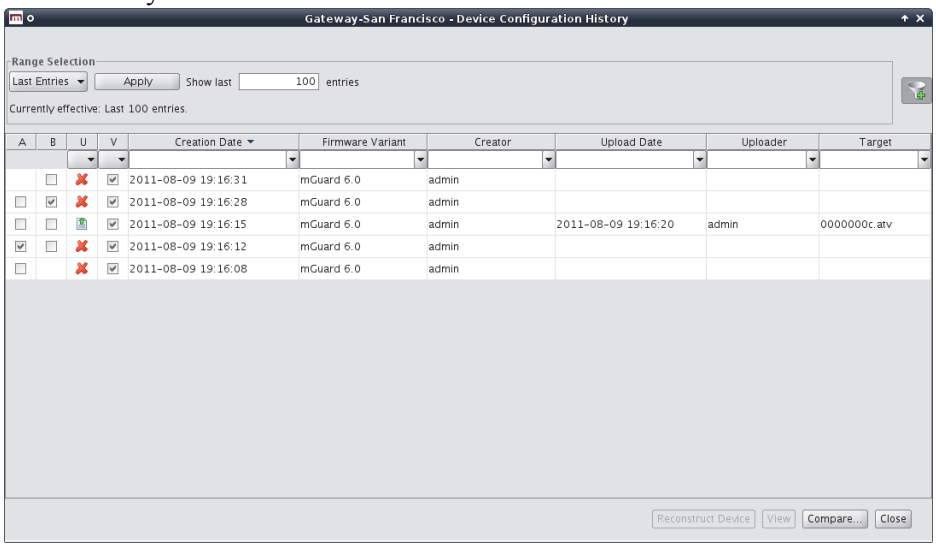


Figure 40: The configuration history dialog

Range selection

Since a device may have a large number of history entries, not all entries are automatically loaded from the mdm server when the dialog is opened. By changing the criteria in the **Range Selection** field and clicking the **Apply** button, the history entries matching the specified critera can be loaded.

☞ By default, the latest (i.e. newest) 100 entries are loaded.

All Entries

Loads all history entries associated with the device.

☞ If the numer of entries is large (i.e. thousands or more), loading all entries may incur a significant delay.

Time Range

Loads all entries which have been created during a time range. The time range must be specified:

- If a lower bound, but not an upper bound is specified, all entries newer than the lower bound are loaded.
- If an upper bound, but not a lower bound is specified, all entries older than the upper bound are loaded.
- If both a lower and an upper bound are specified, all entries created during the time interval given by the bounds are loaded.

Times are specified as an ISO date (**YYYY-MM-DD** where **YYYY** is the year, **MM** is the month of the year between 01 and 12, and **DD** is the day of the month between 01 and 31) optionally followed by an ISO time (**hh:mm:ss** where **hh** is the hour according to the 24-hour timekeeping system, **mm** is the minute and **ss** is the second). For example, a quarter past 4 p.m. and 20 seconds on December 22nd, 2010 would be written as **2010-12-22 16:15:20**.

Alternatively, click on the icon to select the date from a calender.

Last Entries

Loads the latest (i.e. newest) entries. The number of entries must be specified.

Configuration history table columns

The configuration history table contains the following columns:

☞ The column width can be changed by placing the cursor on the header of the table at the border of two columns and dragging the border to the desired location. The order of the columns can be changed by dragging the column header to a different location.

Selection *A*, *B*

The checkboxes in the **A** and **B** columns are used to "activate" either one or two history entires. The activated history entries are used when an action is performed; please refer to the sections below for more details.

- Check the checkboxes **A** and **B** in the same row to activate the corresponding history entry.
- Check the checkboxes **A** and **B** in different rows to activate two history entires.

☞ When two different history entries are activated, the entry checked in the **A** column is always older than the entry checked in the **B** column. Whenever a checkbox is checked, mdm automatically removes some checkboxes so that it is not possible to reverse the order. Activating two different entries is easiest when the table is sorted by creation date.

Status *U*

The **U** column shows the upload status, if the configuration coressponding to the history entry has been uploaded to an mGuard or exported for pull config. Please refer to Chapter 3.3 for a list of available upload statuses and their meanings. One additional upload status is available in the configuration history dialog:

- Not uploaded
  The configuration coressponding to the history entry has not been uploaded to an mGuard or exported for pull config.

☞ If the same configuration is uploaded or exported two or more times, the latest configuration history entry is duplicated, so that one entry exists for every successful or unsuccessful upload attempt.

Status *V*

The **V** status indicates whether or not the configuration corresponding to the history is valid. A configuration is not valid if a **None** value in a template has not been overridden, so that the configuration cannot be uploaded to an mGuard. Please refer to Chapter 4.1 for more information.

☞ A history entry corresponding to an invalid configuration cannot be activated.

Creation Date

The date and time when the configuration history entry was created.

Version

The firmware version that was set for the device when the configuration history

entry was created.

Creator

The username of the user who made the change to a device, template, or VPN group configuration that caused the configuration history entry to be created.

Upload Date

The date and time when the configuration corresponding to the history entry was uploaded to an mGuard or exported for pull config. Empty if the configuration has not been uploaded or exported.

Uploader

The username of the user who initiated the upload or export. Empty if the configuration has not been uploaded or exported.

Target

- If the configuration has been uploaded, the address to which it has been uploaded.
- If the configuration is exported, the name of the file to which it has been exported.
- Otherwise empty.

Filtering and sorting the table

The header of the table can be used to sort the table entries. A click on a header of a column will activate the (primary) sort based on this column. This is indicated by the arrow in the column header. A second click on the same header will reverse the sort order. Clicking on another column header activates the sort based on this new column, the previously activated column will be used as secondary sorting criterion.

The first row of the table accepts the input of regular expressions (please refer to Chapter 8, *Regular expressions*), which can be used to efficiently filter the table entries. Filtering based on regular expressions is not used for columns that do not contain text (columns **U** or **V**).

Since the **A** and **B** columns do not contain information, but are used to activate history entries, they cannot be used for filtering or sorting.

Detail information

Double clicking on a row in the configuration history dialog opens a dialog which displays detail information about the configuration history entry. In particular, if the configuration has been uploaded, the messages received from the mGuard while applying the configuration are shown.

6.2 Viewing historic configurations

When a single history entry is activated in the configuration history dialog, the **View** button is enabled. Clicking on this button opens the *History View Dialog* which shows the historic configuration.

☞ Although the *History View Dialog* looks similar to the *Device Properties Dialog*, the type of information that is visualized is different. History entries contain configurations as they are uploaded to the mGuards; variable permissions and template inheritance relations are not part of the history.

Special values

In addition to the variable value (or **Custom** if the variable value cannot be displayed, e.g. password variables), two special values are used:

- **Local** indicates that the variable has no value known to mdm. The value is set by the user *netadmin* on the mGuard.
- **Custom + Locally appendable** is only applicable to table variables. It indicates that the user *netadmin* on the mGuard has the permission to append rows to the table.

6.3 Comparison of historic configurations

When two history entries are activated in the configuration history dialog, the **Compare** button is enabled. Clicking on this button opens the *History Comparision Dialog* which shows a comparison of the two historic configurations.

☞ Although the *History Comparision Dialog* looks similar to the *Device Properties Dialog*, the type of information that is visualized is different. History entries contain configurations as they are uploaded to the mGuards; variable permissions and template inheritance relations are not part of the history.

Navigation tree

Different icons and colors in the navigation tree are used to visualize where and how the older and newer configuration differ:

- Unchanged (black label)
  The older and newer configuration are identical in the subtree below the node.
- Modified (blue label)
  Variables have changed between the older and newer configuration in the subtree below the node.
- Added (green label)
  The subtree has been added, i.e. it exists in the newer, but not in the older configuration.
- Removed (red label)
  The subtree has been removed, i.e. it exists in the older, but not in the newer configuration.

Configuration variables

If a variable has not changed between the older and newer configuration, its single value is displayed. Otherwise, if a simple variable has changed, its old value is displayed above its new value. In cases where the variable value cannot be displayed (e.g. password variables), the text **Custom** is used instead.

☞ If the single value **Custom** is displayed for a password variable, this indicates that the password has not changed. However, if the value **Custom** is displayed twice, the password has changed between the older and the newer configuration.

If a table variable has changed, the change is indicated by the background color of the changed row(s) and by a character in the "+/–" column:

- "+" indicator / green background
  The row has been inserted, i.e. it exists in the newer, but not in the older configuration.
- "–" indicator / red background
  The row has been deleted, i.e. it exists in the older, but not in the newer configuration.
- "M" indicator / blue background
  The row has changed between the older and newer configuration. This indicator is only used for complex table variables (e.g. VPN connections); otherwise, a changed row is treated as a deletion of the row with the old contents followed by an insertion of a row with the new contents.

Special values

In addition to the variable value or **Custom**, two special values are used:

- **Local** indicates that the variable has no value known to mdm. The value is set by the user *netadmin* on the mGuard.
- **Custom + Locally appendable** is only applicable to table variables. It

indicates that the user *netadmin* on the mGuard has the permission to append rows to the table.

6.4 Reconstructing a device from a historic configuration

When a single history entry is activated in the configuration history dialog by checking the checkboxes in both the **A** and the **B** column, the **Reconstruct Device** button is enabled. Clicking on this button creates a new device in which all variables are set according to the historic configuration and opens the *Device Properties Dialog* for the reconstructed device.

☞ Once created, the new device is no longer linked to the device from which it has been reconstructed. It is an independent device with an independent device history.

Template assignment

If the device was assigned to a template when the history entry was created, and if that template still exists, and if the firmware version the device had when the history entry was created is equal to or newer than the current firmware version of the template, the template can be assigned to the reconstructed device:

If the template is assigned to the device, variables in the device are set to **Inherited** if their value (in the historic configuration) matches the value in the template (in its current state).

☞ If the template uses the **No override** or **May append** permission, it may not be possible to reproduce the historic configuration exactly.

6.5 Report of changes

The report of changes allows it to obtain an overview how multiple devices have changed between two points in time. Select one or more devices in the device overview table and activate the **Generate Report of Changes to Device Configuration** option in the context menu. This opens the history reporting dialog.

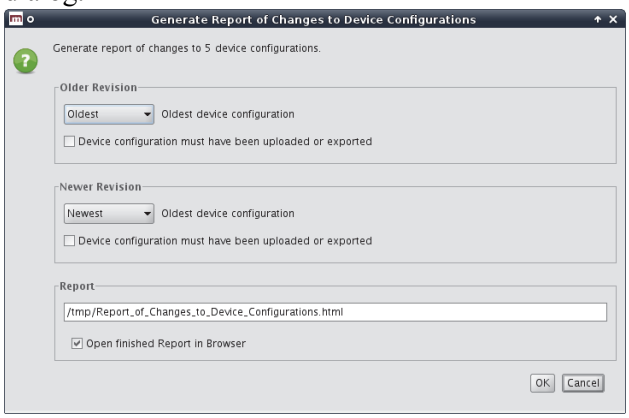


Figure 41: The dialog to generate a report of changes to device configurations

Selection criteria

The two historic configurations to compare are selected by applying two selection criteria, one to select the older revision and one to select the newer revision, to each selected device individually. The following criteria can be chosen:

Oldest

The oldest device configuration.

Newest

The newest device configuration.

Newest Before

The newest device configuration prior to a date and time. The date and time is specified as an ISO date (**YYYY-MM-DD** where **YYYY** is the year, **MM** is the month of the year between 01 and 12, and **DD** is the day of the month between 01 and 31) optionally followed by an ISO time (**hh:mm:ss** where **hh** is the hour according to the 24-hour timekeeping system, **mm** is the minute and **ss** is the second). For example, a quarter past 4 p.m. and 20 seconds on December 22nd, 2010 would be written as **2010-12-22 16:15:20**.

Alternatively, click on the icon to select the date from a calender.

Device configuration must have been uploaded or exported

The criterion can be combined with the others. If the checkbox is checked, only history entries pertaining to configurations which have been uploaded to an mGuard or exported for pull configuration are considered.

Generating the report

The report consists of an HTML file which can be viewed with any web browser. The name of the file to which to write the report is specified in the **Report** field. If the **Open finished Report in Browser** checkbox is checked, mdm automatically opens a web browser and loads the report.

7 Creating and managing certificates

It is assumed that the reader has a basic knowledge of certificates and public key encryption.

This chapter explains the usage of *OpenSSL* to create certificates.

It is important to note that mdm requires two different types of certificates and keys:

- Certificates and keys used to secure the communication between the mdm components.
- Certificates and keys used for the PKI.

How to create certificates and keys to be used for the SSL communication is explained in Chapter 7.1. The certificates and keys used in a PKI are described in Chapter 7.2.

☞ Please note that the process described in this section to create certificates is just one example of the usage of OpenSSL. There are also alternative ways to create your certificates. If you are not familiar with *OpenSSL* you should *exactly* follow the instructions below.

☞ The use of OpenSSL 0.9.8zc, 1.0.0o or 1.0.1j or newer is recommended, due to the support of SHA-256 and several important security fixes. If you would like to use an OpenSSL version older than version 0.9.8 you have to use a digest algorithm supported by your version in the commands.

Keystores

Certificates and keys are stored in databases called keystores. A keystore is a file, containing the certificates and keys in encrypted form. To access the information in a keystore a passphrase is required. Keystores can have different formats, common formats are e.g. *PKCS#12* or the proprietary Java Keystore format (JKS). The encryption algorithm can usually be selected when creating the keystore. 3DES is recommended.

The *OpenSSL* configuration file

OpenSSL uses default values specified in the configuration file *openssl.cnf* (the directory where this file is located depends on your distribution, e.g. check in the directory */usr/ssl* or */usr/lib/ssl*).

If you omit mandatory arguments of a command, OpenSSL uses the default settings defined in the configuration file. If possible, all mandatory arguments for the example commands below are explicitly stated, i.e. if you use the commands as described below the important information is taken from the command line and not from the configuration file. If the configuration file is required for the respective command it is explicitly mentioned in the text.

For further information about the syntax and content of the configuration files, please refer to OpenSSL's documentation, particularly to the manual pages genrsa(1ssl), req(1ssl), ca(1ssl) and openssl(1ssl).

7.1 Certificates and keys for SSL

To set up a secure connection between entities (e.g.: ET1, ET2) usually the following components are required

- a private key for each entity participating in the communication:
  - $ET1_{key}$
  - $ET2_{key}$

  The term *private key* already implies that it is important to keep these keys private and store them at a location only accessible to the administrator.

- and the corresponding certificates:
  - $ET1_{cert}$
  - $ET2_{cert}$

  The certificates contain among other information
  - the public key of the entity
  - information about the entity, e.g. the name and/or the IP address
  - further information about the certificate, e.g. the intended usage

  The certificate is either digitally signed with the private key of the respective entity (self-signed) or with a CA key.

  The certificates are public and can be distributed to anyone participating in the communication.

ET1 will use the public key contained in $ET2_{cert}$ to encrypt the data sent to ET2. This assures that only ET2 is able to decrypt the data. If $ET2_{cert}$ is self-signed it is assured that public key contained in $ET2_{cert}$ corresponds to $ET2_{key}$. If $ET2_{cert}$ is signed by a CA it is assured that the public key contained in $ET2_{cert}$ really belongs to ET2 (authentication).

Create the private key

ET_{key} has to be created first using the following command:

```
openssl genrsa -des3 -passout pass:yourSSLPW
-out privkey.pem 2048
```

Explanation of the arguments:

genrsa

genrsa instructs *OpenSSL* to generate an RSA key.

-des3

Use 3DES to encrypt the key.

-passout pass:*password*

The password used to encrypt the private key (in the example: *yourSSLPW)*. *yourSSLPW* is just an example and should be replaced by a secure password.

-out *filename*

Name of the file containing ET_{key} (in the example: `privkey.pem`).

2048

The length of the key.

The command above generates one output file:

- *privkey.pem*

  This file contains ET_{key} in *PEM* format. The key is encrypted with the 3DES-algorithm. To access the key you have to know the passphrase specified above (in the example: *yourSSLPW*). Please use your own, secure password to encrypt the private key.

  ☞ Sometimes it is necessary to create an unencrypted key. In this case just omit the *-des3* and the *-passout* option in the command above.

Create the certificate

The certificate is created with the following command:

```
openssl req -batch -new -x509 -key privkey.pem
-keyform PEM -passin pass:yourSSLPW -sha256
-outform PEM -out serverCert.pem
```

Explanation of the arguments:

req

req instructs *OpenSSL* to generate a certificate request (default) or a certificate.

-batch

Non interactive mode.

-new

Create a new request or a new certificate.

-x509
Create a self signed certificate instead of a certificate request.

-key *filename*
The corresponding private key (in the example: `privkey.pem`).

-keyform PEM
The private key is in *PEM* format.

-passin pass:*password*
Password required to decrypt the private key (in the example: *yourSSLPW*).

-sha256
Use the SHA256 algorithm to create the message digest for the signature (recommended).

-outform PEM
The format of the output file is *PEM*.

-out *filename*
The name of the output file, i.e. the certificate (in the example `serverCert.pem`).

The command above generates one output file:

- `serverCert.pem`
  This file contains the self-signed certificate ET_{cert}.

Create a keystore

The keys and certificates have to be included in keystores. The installation archive *mdm-ca-1.6.x.zip* contains the (proprietary) java tool *ImportKey* in the *demoCA* directory which can be used to create and manage keystores. Please copy the file *ImportKey.class* to your working directory.

First ET_{key} has to be converted to *PKCS#8* format and both ET_{key} and ET_{cert} have to be included in a keystore. In the example, Java keystore format *JKS* is used. This can be accomplished with the tool *ImportKey*. *ImportKey* does accept the (unencrypted) key on standard input only, therefore the output of the *pkcs8* command has to be piped as follows:

```
openssl pkcs8 -topk8 -in privkey.pem
-passin pass:yourSSLPW -inform PEM -nocrypt -outform DER |
java -cp . ImportKey -alias yourAlias -storetype JKS
-keystore serverKeystore.jks -storepass pass:yourSSLPW
-keypass pass:yourSSLPW -chain serverCert.pem
```

Explanation of the *openssl* arguments:

pkcs8
The *pkcs8* command is used to process private keys in *PKCS#8* format.

-topk8
Use a traditional format private key as input and write a key in *PKCS#8* format key.

-in *filename*
The name and the location of the input file (in the example: *privkey.pem*).

-passin pass:*password*
Password required to decrypt the input (in the example: *yourSSLPW*).

-inform PEM
The input format of the key is *PEM*.

-nocrypt
The output (the key) is not encrypted.

-outform DER

The ouput format is DER.

Explanation of the *ImportKey* arguments:

-alias *name*
A keystore can contain multiple entries. The alias identifies the entry and therefore has to be unique in the keystore. Aliases are case-insensitive.

-keystore *filename*
The file containing the keystore (in the example: `serverKeyStore.jks`).

-storetype JKS
Use JKS as format for the keystore.

-storepass pass:*password*
Password required to decrypt the contents of the keystore (in the example: *yourSSLPW*).

-keypass pass:*password*
Additional password required to decrypt the private key in the keystore.

-chain *filename*
The certificate (in the example *serverCert.pem*).

The command above creates one output file:

- *serverKeyStore.jks*
  This is the keystore containing the certificate and the private key.

Import a certificate

After creating the keystore it is sometimes necessary to import additional certificates into the keystore. This can be accomplished by using the following command:

```
java -cp . ImportKey -alias yourAlias -storetype JKS
-file additionalCertificate.pem -storepass pass:yourSSLPW
-keystore serverKeystore.jks
```

Explanation of the *ImportKey* arguments:

-alias *name*
A keystore can contain multiple entries. The alias identifies the entry and therefore has to be unique in the keystore. Aliases are case-insensitive.

-keystore *filename*
The file containing the keystore (in the example: `serverKeyStore.jks`).

-storetype JKS
The format for the keystore.

-storepass pass:*password*
Password required to decrypt the contents of the keystore (in the example: *yourSSLPW*).

-file *filename*
The certificate to be imported (in the example `additionalCertificate.pem`).

7.2 Certificates and keys for a PKI

When rolling out a Private Key Infrastructure (PKI), which is basically your intent when using the mdm CA, there are more requirements to be taken into account than mentioned in the previous chapter. This chapter first describes some of the PKI basics and then the usage of *OpenSSL* to roll out a PKI.

☞ Please note that the certificates described in this section are not used for SSL.

☞ Please note that the certificates and keys described in this section are not stored in the SSL-keystore of the mdm CA, but in the CA-keystore.

PKI basics

Among others the main reasons for using a PKI are:

- Authentication
  When communicating using data networks it is in most cases not possible to "see" the entity on the remote side (exception: video telephony), i.e. one cannot be sure that the entity on the remote side is the one it claims to be. The usage of a PKI assures the authenticity of the entities communicating with each other.
- Data confidentiality
  This is the reason VPNs are used to exchange data: The data packets are sent "in the public" (Internet), but unauthorized entities are prevented from accessing the information contained in the packets.
- Data integrity
  The assurance that the information received is identical to the information sent by the other entity. This prevents information to be altered by an entity "in the middle" which is not authorized to participate in the communication.

It is beyond the scope of this document to describe all components and their interactions involved in a complete PKI, therefore only the most important are mentioned here:

- Certificates and private keys
  Certificates are the means in a PKI to assure authentication. The identity of the certificate owner is approved by a CA by signing the certificate request of the respective owner. The public and private keys are used to encrypt/decrypt data and therefore assure data confidentiality.
- Certification Authority (CA)
  A *Certification Authority* is a component in a PKI which assures authenticity of the participating entities by signing certificate requests (i.e. issuing certificates). Usually there are multiple CAs in a PKI organized in a hierarchical structure with one root CA at the top.
- CRL Distribution Points (CDP)
  See the following section *Certificate extensions*.
- Entities communicating with each other
  The entities using a PKI use certificates to authenticate themselves and use the public/private key pairs to encrypt/decrypt the exchanged data. The entities request certificates from the CA. Usually a *Registration Authority* (RA) is also part of a PKI. The RA is responsible for the initial registration of entities that would like to use the PKI. An RA is not required in the mdm usage scenario.

Contents of a certificate

As mentioned in the previous chapter a certificate contains the following information:

- the public key of the entity
- information about the entity, e.g. the name and/or the IP address
- further information, e.g. about the certificate and the infrastructure

The following sections explain the contents in more detail.

The Subject Distinguished Name

The *Subject Distinguished Name* is a unique identifier of the certificate and its owner. It is composed of several components:

Abbreviation	Name	Explanation
CN	Common Name	Identifies the person or object owning the certificate. For example: CN=server1
E	E-mail Address	Identifies the e-mail address of the owner.
OU	Organizational Unit	Identifies a unit within the organization. For example: OU=Research&Development
O	Organization	Identifies the organization. For example: O=Innominate
L	Locality	Identifies the place where the entity resides. The locality can e.g. be a city: L=Berlin
ST	State	Identifies the state. For example: ST=Berlin
C	Country	Two letter code identifying the country. For example: C=DE (for Germany)

Depending on your policy, not all of the components are mandatory, but if the extension *Subject Alternative Name* is not included in the certificate, at least one component that can be used as identifier has to be included, typically this is the *Common Name* (CN). Please note that currently the mdm CA cannot handle certificates with *Subject Alternative Name* extensions.

Certificate extensions

Information about the certificate or the infrastructure is contained in the so called certificate extensions. Basically anyone can define its own extensions, but the standard extensions (X.509version3) are defined in RFC 3280 *Internet X.509 Public Key Infrastructure - Certificate and CRL Profile*. Here is a short description of the extensions that are important for the mdm CA:

Critical Bit

The *Critical Bit* is not an extension but used to force the usage of extensions in the certificate. The *Critical Bit* can be set for any extensions in the certificate. Applications verifying a certificate must be able to interpret an extension with the *Critical Bit*. If the application is not able to interpret the extension, the certificate must be rejected.

Basic Constraints

The *Basic Constraints* extension is used to indicate whether the certificate is a CA certificate or not. *Basic Constraints* consists of 2 fields:

- *cA* field of type BOOLEAN and
- *pathLenConstraint* field (optional) of type INTEGER

For CA certificates the *cA* field must be set to *true*. *pathLenConstraint* is only used if the *cA* field is set to true and specifies the number of CA levels allowed below this certificate. *Basic Constraints* should be always marked as critical. Please refer to Chapter 7.2.3 for requirements regarding the *Basic Constraints* extension.

Key Usage

Key Usage controls the intended use of the certificate's corresponding keys. A key can be e.g. used to sign Certificate Revocation Lists (CRL), encrypt data or to sign certificates.

Please refer to Chapter 7.2.3 for requirements regarding the *Key Usage* extension.

Subject Alternative Name

The extension *Subject Alternative Name* can be used to add more identifiers to the certificate. *Subject Alternative Name* can contain e.g. e-mail addresses, domain names etc. It can be used as substitute for the *Subject* as well, which must be empty in this case. Please note that the mdm CA is currently not able to handle *Subject Alternative Name* extensions.

CRL Distribution Points (CDP)

Certificates can be revoked, e.g. if a private key was compromised or if it is no longer valid. Usually an application has to check whether a certificate is still valid, by checking the validity period and/or by retrieving revocation information from a CRL distribution point (CDP). To retrieve the information either *Certificate Revocation Lists* (CRL) can be used or a dedicated protocol like OCSP. However, the certificate should contain the information, which CDP should be contacted.

Authority Information Access

Authority Information Access is not an X.509 standard extension, but an extension defined by the PKIX working group (http://www.ietf.org/html.charters/pkix-charter.html). *Authority Information Access* contains information about the issuing CA, e.g. policies, further root certificates or where to retrieve the higher certificates in the chain, if the complete chain is not contained in the certificate.

Depending on the settings of these extensions the receiver (not the owner) of a certificate accepts or denies the communication with the peer, thus preventing any misuse of certificates and creating a higher level of security.

7.2.1 Create the CA certificates

Depending on your existing infrastructure the mdm CA needs the following certificates:

- A self-signed root certificate ($CA_{rootCert}$) and the matching private key ($CA_{rootKey}$).

  If you have another upstream (root) CA in place, there is no need to generate the root certificate and the matching private key.

  The (self-signed) root certificate is distributed to all entities participating in the communication. It is used by the entities to verify the authenticity of the communication peer and of any intermediate CAs in the certificate chain. The private key $CA_{rootKey}$ is used to sign the self-signed root certificate.
- A CA certificate (CA_{cert}) and the matching private key (CA_{key}). This is the certificate used by the CA to authenticate itself to other entities. This certificate has to be signed with the root private key, i.e. either with $CA_{rootKey}$ or with the key of your existing root CA. The private key CA_{key} is used to sign the certificate request sent by the mdm server, i.e. it is used to issue certificates for the mGuards.

- A template certificate ($CA_{templCert}$) which is used by the CA as template when issuing end entity (mGuard) certificates.

Figure 42 shows the certificate hierarchy:

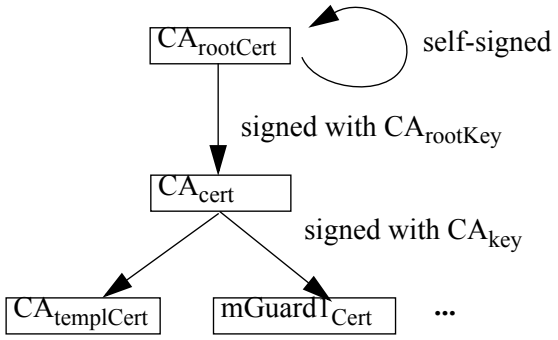


Figure 42: mdm CA certificate hierarchy

In the following it is assumed that there is no other root CA in place and that the mdm CA is used as root CA.

☞ **Important**: Please keep the private key(s) at a secure location. In particular this is required for the root CA's private key.

☞ It is recommended to create a working directory, e.g. called *security* in the mdm installation directory, where all the certificates and keys created during the following process are located.

Create the root certificate

The following *OpenSSL* commands require input from the *OpenSSL* configuration file *openssl.cnf* (the directory where this file is located depends on your distribution, e.g. check in the directory */usr/ssl* or */usr/lib/ssl*). Instead of changing the standard configuration file of your *OpenSSL* installation, it is recommend to use the example configuration files provided in the mdm CA installation archive *mdm-ca-1.6.x.zip* and adapt those files to your needs. You can instruct *OpenSSL* to use the provided configuration files instead of the standard configuration file.

Adapt the OpenSSL configuration file

Please copy the file *rootCert.conf* provided in the installation archive *mdm-ca-1.6.x.zip* to your working directory. Adapt the `[ root_dn ]` section of the file, which contains the *Subject Distinguished Name* of your root CA certificate:

```
[ root_dn ]
C= DE
O= Innominate Security Technologies AG
OU= Research & Development
CN= Test Root CA
```

Please note also the `[ root_ext ]` section of the configuration file, which is important for the proper generation of the root certificate (please refer to Section *Certificate extensions* for an explanation):

```
[ root_ext ]
keyUsage= cRLSign, keyCertSign
basicConstraints= critical, CA:true, pathlen:1
```

Generate the private key

$CA_{rootKey}$ has to be created first using the following command:

```
openssl genrsa -des3 -passout pass:rootPW
-out rootKey.pem 2048
```

Explanation of the arguments:

genrsa
: *genrsa* instructs *OpenSSL* to generate an RSA key.

-des3
: Use 3DES to encrypt the key.

-passout pass:*password*
: The password used to encrypt the private key (in the example: *rootPW*). *rootPW* is just an example and should be replaced by a secure password.

-out *filename*
: Name of the file containing $CA_{rootKey}$ (in the example: `rootKey.pem`).

2048
: The length of the key.

The command above generates one output file:

- *rootKey.pem*

This file contains $CA_{rootKey}$ in *PEM* format. The key is encrypted with the 3DES-algorithm. To access the key you have to know the passphrase specified above (in the example: *rootPW*). Please use your own, secure password to encrypt the private key.

Generate the root certificate

The OpenSSL command used to generate $CA_{rootCert}$ is:

```
openssl req -batch -new -config rootCert.conf -x509
-key rootKey.pem -keyform PEM -passin pass:rootPW -sha256
-days 5479 -outform PEM -out rootCert.pem
```

Explanation of the arguments:

req
: *req* instructs *OpenSSL* to generate a certificate request (default) or a certificate.

-batch
: Non interactive mode.

-new
: Create a new request or a new certificate.

-config *filename*
: The name and the location of the openssl configuration file (in the example: `rootCert.conf`).

-x509
: Create a self signed certificate instead of a certificate request.

-key *filename*
: The corresponding private key (in the example: `rootKey.pem`).

-keyform PEM
: The private key is in *PEM* format.

-passin pass:*password*
: Password required to decrypt the private key (in the example: *rootPW*).

-sha256
: Use the SHA256 algorithm to create the message digest for the signature (recommended).

-days ***5479***
The period for which the certificate will be valid.

-outform PEM
The format of the output file is *PEM*.

-out ***filename***
The name of the output file, i.e. the certificate (in the example `rootCert.pem`).

The command above generates one output file:

- `rootCert.pem`
  This file contains the self-signed root certificate $CA_{rootCert}$.

Create the CA certificate

The intermediate CA certificate CA_{cert} is not self-signed but will be issued (signed) by the root CA. Therefore you first have to create a private key and a corresponding certificate request and then "send" this certificate request to the root CA. The root CA will in return issue CA_{cert}.

First the configuration file has to be adapted to your needs, as described in the previous section.

Adapt the OpenSSL configuration file and the environment

Please copy the file *caCert.conf* contained in the installation archive *mdm-ca-1.6.x.zip* to your working directory. Adapt the [ca_dn] section of the file, which contains the *Subject Distinguished Name* of your root CA certificate:

```
[ ca_dn ]
C= DE
O= Innominate Security Technologies AG
OU= Research & Development
CN= Test CA
```

Please adapt also entries `crlDistributionPoints` and `authorityInfoAccess` of the [ca_ext] section of the configuration file (please refer to Section *Certificate extensions* for an explanation):

```
[ ca_ext ]
crlDistributionPoints=URI:http://ca.example.com/ca-
ca.crl
authorityInfoAccess=OCSP;URI:http://ca.example.com/ocsp/
ca-ca
```

The configuration file contains some parameters, which cannot be entered on the command line. The entries specify files that *have* to be present in the file system. Therefore the files have to be created manually first (the filenames are also used in the configuration file *caCert.conf* , therefore please use exactly the file names as stated below):

- Create a subdirectory *archive* in your working directory
  (Linux: `mkdir ./archive`)
- Create a file named *serial* containing a valid serial number for the certificate in the subdirectory *archive*
  (Linux: `echo 1234 > archive/serial`)
- Create an empty file to be used as openssl database.
  (Linux: `touch archive/index.txt`
  Windows: `copy NUL: archive/index.txt`)

Generate a private key

The private key CA_{key} has to be created first using the following command:

```
openssl genrsa -des3 -passout pass:caPW
-out caKey.pem 2048
```

Explanation of the arguments:

genrsa
: *genrsa* instructs *OpenSSL* to generate an RSA key.

-des3
: Use 3DES to encrypt the key.

-passout pass:*password*
: The password used to encrypt the private key (in the example: *caPW*). *caPW* is just an example and should be replaced by a secure password.

-out *filename*
: Name of the file containing the private key (in the example: `caKey.pem`).

2048
: The length of the key.

This command creates one output file:

- *caKey.pem*
  This file contains CA_{key} in *PEM* format. The key is encrypted with the 3DES-algorithm. To access the key you have to know the passphrase specified above (in the example: *caPW*). Please use your own, secure password to encrypt the private key.

Generate a certificate request

To create a certificate request enter the following command:

```
openssl req -batch -new -config caCert.conf
-key caKey.pem -keyform PEM -passin pass:caPW -sha256
-out caCertReq.pem -outform PEM
```

Explanation of the arguments:

req
: *req* instructs *OpenSSL* to generate a certificate request (default) or a certificate.

-batch
: Non interactive mode.

-new
: Create a new request.

-config *filename*
: The name and the location of the openssl configuration file (in the example: `caCert.conf`).

-key *filename*
: The corresponding private key (in the example: `caKey.pem`).

-keyform PEM
: The private key is in *PEM* format.

-passin pass:*password*
: Password required to decrypt the private key (in the example: *caPW*).

-sha256
: Use the SHA256 algorithm to create the message digest for the signature (recommended).

-outform PEM
: The format of the output file is *PEM*.

-out *filename*
The name of the output file, i.e. the certificate (in the example `caCertReq.pem`).

The command above generates one output file:

- *caCertReq.pem*
  This file contains the certificate request.

Request the CA certificate

The request has to be sent to the root CA. Since the mdm CA is the root CA in the example you can issue the certificate with the following command:

```
openssl ca -batch -config caCert.conf -days 3653
-in caCertReq.pem -cert rootCert.pem -keyfile rootKey.pem
-passin pass:rootPW -md sha256 -notext -out caCert.pem
-outdir .
```

Explanation of the arguments:

ca
The *ca* command is a minimal CA application. It can be used to sign certificate requests and generate CRLs.

-batch
Non interactive mode.

-config *filename*
The name and the location of the openssl configuration file (in the example: `caCert.conf`).

-days *3653*
The period for which the certificate will be valid.

-in *filename*
The name of the file containing the certificate request (in the example: `caCertReq.pem`).

-cert *filename*
The name of the file containing the root certificate (in the example: `rootCert.pem`).

-keyfile *filename*
The name of the file containing the key used to sign the certificate request (in the example: `rootKey.pem`).

-passin pass:*password*
Password required to decrypt the private key (in the example: *rootPW*).

-md sha256
Use the SHA256 algorithm to create the message digest for the signature (recommended).

-notext
openssl has an option to include human readable, explanatory text in the certificate. But this would create problems later in the process when creating the keystores, therefore do not include any text in the certificate.

-outdir *directoryName*
The output directory (in the example the current working directory ".").

The command above generates one output file:

- *caCert.pem*
  This file contains CA_{cert}.

☞ The file *caCertReq.pem* is not required any more and should be deleted.

Create a certificate template

The purpose of the CA is to issue certificates. To do so the CA needs instructions how the certificates to be issued should look like, e.g. which extensions should be included. This can be accomplished by providing the CA with a certificate template ($CA_{templCert}$). $CA_{templCert}$ is a certificate issued by the CA. To issue a certificate you first have to adapt an OpenSSL configuration file again.

Adapt the OpenSSL configuration file

Please copy the file *templateCert.conf* contained in the installation archive *mdm-ca-1.6.x.zip* to your working directory. Adapt the entries `crlDistributionPoints` and `authorityInfoAccess` of the [template_ext] section of the configuration file (please refer to Section *Certificate extensions* for an explanation):

```
[ template_ext ]
crlDistributionPoints=URI:http://ca.example.com/ca-
ee.crl
authorityInfoAccess=OCSP;URI:http://ca.example.com/ocsp/
ca-ee
```

☞ Please note that the configuration file *templateCert.conf* expects files to be existent that have to be manually created. (see previous section *Create the CA certificate*, subsection *Adapt the OpenSSL configuration file and the environment*).

Generate a private key

The private key has to be created first using the following command:

```
openssl genrsa -des3 -passout pass:caPW
-out templateKey.pem 2048
```

Explanation of the arguments:

genrsa
genrsa instructs *OpenSSL* to generate an RSA key.

-des3
Use 3DES to encrypt the key.

-passout pass:*password*
The password used to encrypt the private key (in the example: *caPW*). *caPW* is just an example and should be replaced by a secure password.

-out *filename*
Name of the file containing the private key (in the example: *templateKey.pem*).

2048
The length of the key.

This command creates one output file:

- *templateKey.pem*
  This file contains the encrypted private key.

Generate a certificate request

To create a certificate request enter the following command:

```
openssl req -new -batch -config templateCert.conf
-key templateKey.pem -keyform PEM -passin pass:caPW
-sha256 -outform PEM -out templateCertReq.pem
```

Explanation of the arguments:

req
req instructs *OpenSSL* to generate a certificate request (default) or a certificate.

-batch
Non interactive mode.

-new
Create a new request or a new certificate.

-config *filename*
The name and the location of the openssl configuration file (in the example: *templateCert.conf*).

-key *filename*
The corresponding private key (in the example: *templateKey.pem*).

-keyform PEM
The private key is in *PEM* format.

-passin pass:*password*
Password required to decrypt the private key (in the example: *caPW*).

-sha256
Use the SHA256 algorithm to create the message digest for the signature (recommended).

-outform PEM
The format of the output file is *PEM*.

-out *filename*
The name of the output file, i.e. the certificate (in the example *templateCertReq.pem*).

The command above generates one output file:

- *templateCertReq.pem*
  This file contains the certificate request.

Request the template certificate

The request has to be sent to the (intermediate) CA. You can sign the certificate request (issue the certificate) with the following command:

```
openssl ca -batch -config templateCert.conf -days 1826
-md sha256 -in templateCertReq.pem -keyfile caKey.pem
-cert caCert.pem -passin pass:caPW -notext
-out templateCert.pem -outdir .
```

Explanation of the arguments:

ca
The *ca* command is a minimal CA application. It can be used to sign certificate requests and generate CRLs.

-batch
Non interactive mode.

-config *filename*
The name and the location of the openssl configuration file (in the example: *templateCert.conf*).

-days *1826*
The period for which the certificate will be valid.

-in *filename*
The name of the file containing the certificate request (in the example: *templateCertReq.pem*).

-cert *filename*
The name of the file containing the root certificate (in the example: *caCert.pem*).

-keyfile *filename*
The name of the file containing the key used to sign the certificate request (in the example: *caKey.pem*).

-passin pass:*password*
Password required to decrypt the private key (in the example: *caPW*).

-md sha256
Use the SHA256 algorithm to create the message digest for the signature (recommended).

-notext
openssl has an option to include human readable, explanatory text in the certificate. But this would create problems later in the process when creating the keystores, therefore do not include any text in the certificate.

-outdir *directoryName*
The output directory (in the example the current working directory ".").

The command above generates one output file:

- *templateCert.pem*
  This file contains $CA_{templCert}$. The file should be copied to its final destination, the location must be configured in *ca-preferences.xml* in the node
  certificateFactory » certTemplate
  ☞ The files *templateCertReq.pem* and *templateKey.pem* are not needed any more and should be deleted.

7.2.2 Create the keystores

After following the steps described in Chapter 7.2.1 you should find the following files in your working directory:

- *templateCert.pem*
  This file contains $CA_{templCert}$, signed with CA_{key}.
- *caCert.pem*
  This file contains CA_{cert}, signed with$CA_{rootKey}$.
- *caKey.pem*
  This file contains CA_{key}.
- *rootCert.pem*
  This file contains the self-signed root certificate $CA_{rootCert}$.
- *rootKey.pem*
  This file contains the encrypted private root key $CA_{rootKey}$.

Some of those files have to be included in keystores. The installation archive *mdm-ca-1.6.x.zip* contains the (proprietary) java tool *ImportKey* in the demoCA directory which can be used to create and manage keystores. Please copy the file *ImportKey.class* to your working directory.

First the intermediate CA certificate and the root certificate have to be merged into one file (create a certificate chain):

```
cat caCert.pem rootCert.pem > caCertWithChain.pem
```

Then the key *caKey.pem* has to be converted to *PKCS#8* format and both CA_{key} and the certificate chain have to be included in a *PKCS#12* keystore. This can be accomplished with the tool *ImportKey*. *ImportKey* does accept the (unencrypted) key on standard input only, therefore the output of the *pkcs8* command has to be piped as follows:

```
openssl pkcs8 -topk8 -in caKey.pem -passin pass:caPW
-inform PEM -nocrypt -outform DER |
java -cp . ImportKey -alias ca -keystore ca-keystore.jks
-storetype JKS -storepass pass:caPW -keypass pass:caPW
-chain caCertWithChain.pem
```

Explanation of the *openssl* arguments:

pkcs8
: The *pkcs8* command is used to process private keys in *PKCS#8* format.

-topk8
: Use a traditional format private key as input and write a key in *PKCS#8* format key.

-in *filename*
: The name and the location of the input file (in the example: *caKey.pem*).

-passin pass:*password*
: Password required to decrypt the input (in the example: *caPW*).

-inform PEM
: The input format of the key is *PEM*.

-nocrypt
: The output (the key) is not encrypted.

-outform DER
: The output format is DER.

Explanation of the *ImportKey* arguments:

-alias *name*
: A keystore can contain multiple entries. The alias identifies the entry and therefore has to be unique in the keystore. Aliases are case-insensitive.

-keystore *filename*
: The file containing the keystore (in the example: `ca-keystore.jks`).

-storetype JKS
: Use JKS as format for the keystore.

-storepass pass:*password*
: Password required to decrypt the contents of the keystore (in the example: *caPW*).

-keypass pass:*password*
: Additional password required to decrypt the private key in the keystore.

-chain *filename*
: The certificate chain including the root certificate.

The command above creates one output file:

- *ca-keystore.jks*
  This is the keystore for your CA containing the certificate chain and the private CA key. Please copy the keystore to its final destination.
  - The filename including the absolute or relative path of this keystore has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyStore***.
  - The password to access the keystore (in the example *caPW*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyStorePassword***.
  - The format of this keystore (JKS) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyStoreType.***
  - The password to access the private key (in the example *caPW*) has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyPassword.***
  - The alias (*ca*) of the key has to be configured in the *ca-preferences.xml* file in the node ***certificateFactory » keyAlias.***

☞ The file *caCertWithChain.pem* is not needed any more and should be deleted.

7.2.3 Requirements for certificates

For proper function of the VPN certificates also with future versions of the mGuard firmware and the mdm, the certificates have to satisfy the following requirements:

1. The private key should have a length of at least 1024 bits. Innominate recommends a key length of 2048 bits for long term security.
2. Any certificate must conform to RFC 3280.
3. Any CA certificate must contain a *Basic Constraints* extension marked as critical and with the boolean *cA* field set to *true*.
4. Innominate strongly recommends to include the *pathLenConstraint* field in any CA certificate's *Basic Constraints* extension. It must be set to one less than the number of descendant CA certificates. So for a typical scenario where a certification chain is made up of one root CA certificate, a single intermediate CA certificate and an end entity certificate (VPN certificate in this case), the *pathLenConstraint* must be one (1) for the root CA certificate and zero for the intermediate CA certificate.
5. The template VPN certificate must have a *Basic Constraints* extension marked as critical with the boolean *cA* field set to *false* and without a *pathLenConstraint* field.
6. Any CA certificate must contain a *Key Usage* extension marked as critical with the bit *keyCertSign* set. It is recommended to have the bit *cRLSign* set as well.
7. The template VPN certificate does not need to contain any *Key Usage* extension.
8. Any intermediate CA certificate must contain one or both of the extensions *CRL Distribution Points* and *Authority Information Access*, if it is planned to distribute revocation information online with a future release of the mdm and the mGuard firmware. The extensions must be marked as non-critical. The former extension is required if it is intended to use Certificate Revocation Lists (CRLs) in the future. The latter extension is required if it is intended to use the Online Certificate Status Protocol (OCSP, see RFC 2560) in the future. Any of the extensions must contain HTTP URLs only.
9. The template VPN certificate should contain one or both of the extensions *CRL Distribution Points* and *Authority Information Access*, described above, if it is planned to distribute revocation information online in the future. Alternatively, the mdm server can be instructed to include them within the certification request sent to the mdm CA. The latter is more flexible, because this way the location of the revocation information (CRL) respectively information service (OCSP) can be set for groups of devices or even for individual devices.
   Please note: If the template VPN certificate already includes any of the extension and the mdm is instructed to include it within the certification request as well, the extension from the request overrides the one found within the template. The issued certificate will contain the extension copied from the request.
10. The keystore containing the certificates has to contain the complete certificate chain up to and including the root certificate.

8 Glossary

admin / netadmin (on the mGuard)
The user *admin* (mGuard user) can change all settings of the mGuard, whereas the user *netadmin* can change only local variables.

AIA
The certificate extension called Authority Information Access (AIA) indicates how to access CA information and services for the issuer of the certificate in which the extension appears. Such an extension is used to identify the OCSP server which provides current revocation status information for that certificate. mdm supports the inclusion of an AIA extension containing the URL of a single OCSP server. For detailed information on the AIA extension please refer to RFC 3280.

CDP
The certificate extension called CRL Distribution Points (CDP) identifies how CRL information is obtained for the certificate the extension is included in. mdm supports the creation of certificates containing the CDP extension with a single *http://* URL enclosed therein. The URL specifies the download location of the actual CRL. For more detailed information on CRL Distribution Points please refer to RFC 3280.

CRL
A Certificate Revocation List (CRL) is issued regularly by a Certification Authority (CA) to provide (public) access the revocation status of the certificates it issued. A CRL is a list of revoked certificates identified by serial number. Once a certificate is revoked, it is considered to be invalid. A revocation becomes necessary in particular, if associated private key material has been compromised. For more detailed information on CRLs please refer to RFC 3280.

Local (mGuard) variables
Local mGuard variables are not managed by mdm, but only by the *netadmin* locally on the mGuard. Within mdm (in the *Template Properties Dialog* or the *Device Properties Dialog*) each variable can be defined as local variable by selecting **Local** as value.

Inherited value
Devices or templates using a parent template “inherit” the values defined in the parent template. Depending on the permission setting, the inherited value can or cannot be overridden in the inheriting devices and templates.

Management ID
A unique logical identifier independent of the physical hardware that identifies each device, as opposed to an identifier of the physical device, e.g. the serial number.

OCSP
The Online Certificate Status Protocol (OCSP) specifies the message format for a service responding with actual revocation status information on individual certificates upon request. Such a service is conventionally embedded within an HTTP server. Thus most OCSP servers use HTTP as transport layer for the OCSP messages. Such an OCSP server is operated by some Certification Authorities as alternative to or replacement for CRLs. For detailed information on OCSP please refer to RFC 2560.

Permissions

The permissions in a template determine whether the user configuring an inheriting device or template can override/modify the settings of the parent template.

Regular expressions

Regular expressions are text strings to match portions of a field using characters, numbers, wildcards and metacharacters. Regular expressions can be used in mdm to filter the device, template, or pool table. For detailed information on regular expressions please refer to *www.regular-expressions.info*.

Template

A set of mGuard variables and the corresponding values and permissions. The template can be used (i.e. inherited from) by a device or another template. A change in the template applies to all inheriting devices and templates, depending on the access privilege settings. The template is used in mdm only, but not on the mGuard.

See also *Inherited value* and *Permissions*.

X.509 certificates

Digital certificates have been specified in the standard X.509 issued by the ITU-T. A profile of that standard is published as RFC 3280. Such certificates certify the identity of an entity. The certificate includes the entity's public key and an electronic signature from the Certification Authority (CA). X.509 certificates are organized hierarchically: A root CA creates a self signed trust anchor which needs to be configured as such for applications verifying digital signatures or certificates. The identity and trustworthyness of the intermediate CAs is certified with a CA certificate issued by the root CA respectively the upstream intermediate CA. The identity of the end entities is certified with a certificate issued by the lowest CA. Each certificate can contain extensions for the inclusion of arbitary additional information. The mdm supports the creation of end entity certificates for VPN connection end points and the optional inclusion of the CDP and AIA extensions. For detailed information on digital certificates please refer to RFC 3280.

This page is intentionally left blank.